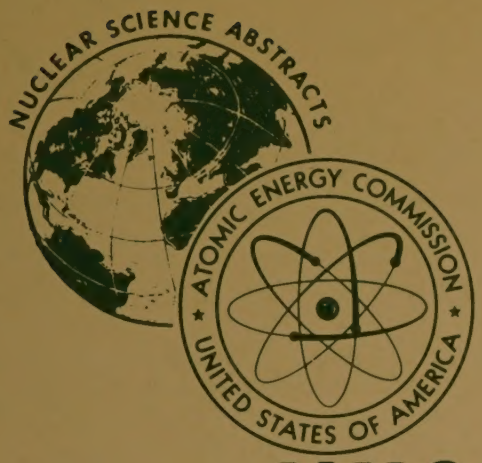

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Volume 15 Number 21

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November 15, 1961

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Volume 15, Number 21 November 15, 1961

NUCLEAR SCIENCE ABSTRACTS

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Use of funds for printing this publication has been approved by the Bureau of the Budget, July 29, 1960.

TABLE OF CONTENTS

Volume 15, Number 21, November 15, 1961

Volume 15, Number 21 November 15, 1961

NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

27254 (AFOSR-TN-60-1395) TRANSIENT AND STEADY STATE BEHAVIOR IN CESIUM ION BEAMS. J. M. Sellen and H. Shelton (Ramo-Wooldridge. Div. of Thompson Ramo Wooldridge Inc., Canoga Park, Calif.). [1960]. Contract AF49(638)-886. (RW-RL-186; AD-250289)

Presented at the American Rocket Society Electrostatic Propulsion Conference, Monterey, California, November 3-4, 1960.

Experiments are described which relate to the transient and steady state behavior of the beams, which were conducted as an extension and a continuation of a program of study of problems of charge neutralization. The results reveal an involved pattern of behavior of the beams for which mechanisms were advanced to account for the behavior of the beams. (B.O.G.)

27255 (LMSD-325466) NEGATIVE AND POSITIVE SURFACE IONIZATION AND THEIR APPLICATIONS TO ELECTROSTATIC PROPULSION. Technical Memorandum. M. A. Gilleo and S. W. Kash (Lockheed Aircraft Corp., Missiles and Space Div., Palo Alto, Calif.). Feb. 1961. 30p. (AD-254907)

The production of negative and positive ions is compared for a range of surface conditions. Consideration is given to the production of ions of either sign from chemically stable alkali-halide vapors. The problem of electron emission by a surface employed in the production of negative ions is examined. Two accelerator designs which employ both positive and negative atomic ions are schematically described. The method of production and acceleration of negative ions is entirely similar to that already developed for positive ions. In one accelerator design, ions of both kinds are produced in a single collinear accelerating unit and emerge mixed. In the other the ions are produced in a checkerboard array of individual positive and negative ion guns and are then drawn together by the electrostatic attraction between the beams and by the effect of the electrostatic repulsion within each beam. Consideration is given to the intermixture of two beams of oppositely charged particles of arbitrary mass ratio. The interaction of beams of alkali-metal ions and halogen ions is compared with the interaction of beams of alkali-metal ions and electrons. (auth)

27256 (NASA-TN-D-876) THEORETICAL PERFORMANCE OF REVERSE-FEED CESIUM ION ENGINES. J. Howard Childs (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1961. 80p.

A theoretical analysis of reverse-feed cesium ion engines indicates the values required for the various engine dimensions in order to optimize performance, and the conditions under which this type engine is of interest for space missions. A comparison with the theoretical performance of porous-tungsten ion engines is included. The reverse-feed ion engine may possibly give higher power efficiencies at low specific impulse. Charge exchange will result in greater electrode erosion in this type engine, necessitating a mechanically complex system for replacement of electrodes. The weight of electrode material consumed will be small relative to the propellant weight. (auth)

27257 (NASA-TN-D-1055) THE NEUTRALIZATION OF ION-ROCKET BEAMS. Harold R. Kaufman (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1961. 33p.

The experimental ion-beam behavior obtained without neutralizers is compared with both simple collision theory and plasma-wave theory. This comparison indicates qualitatively that plasma waves play an important part in beam behavior. The theories of immersed-emitter and electron-trap neutralizer operation are discussed. To the extent permitted by experimental data, these theories are compared with experimental results. Experimental data are lacking completely for operation in space. The results that might be expected in space and the means of simulating such operation in earth-bound facilities are discussed. (auth)

27258 (NP-10461) CONSOLIDATED QUARTERLY PROGRESS REPORT [IN ELECTRONICS] NUMBER 1. (California. Univ., Berkeley. Electronics Research Lab.). May 15, 1961. 70p.

A review is included of activities carried out in research on circuits, microwave electronics and plasmas, radiation and propagation, solid-state electronics, systems, bioelectronics, and electrical equipment. (B.O.G.)

27259 (NP-10493) UNITED KINGDOM ATOMIC ENERGY AUTHORITY, SEVENTH ANNUAL REPORT FOR THE PERIOD APRIL 1, 1960—MARCH 31, 1961. (United Kingdom Atomic Energy Authority, London). July 7, 1961. 80p.

A summary is presented of the activities of the UKAEA which includes discussions of production plants, reactor development, general research and development, controlled thermonuclear research, nuclear weapons, raw materials, commercial operations, health and safety, information services, and international relations. (B.O.G.)

27260 (NYO-2573) APPLICATIONS OF ULTRASONIC ENERGY. TASK 1: CHEMICAL PROCESSING. TASK 2: METAL AND CERAMIC POWDER PROCESSING. TASK 3:

ULTRASONIC INSTRUMENTATION. Progress Report No. 19 Covering Period December 1, 1959 to January 31, 1960. (Aeroprojects Inc., West Chester, Penna.). Mar. 1960. Contract AT(30-1)-1836. 42p.

Ultrasonic Chemical Processing. Pyrometallurgical dissolution of uranium metal slugs in molten cadmium with 2-hr ultrasonic activation resulted in equilibrium concentrations of 2.68 wt.% uranium, in contrast to 0.03 wt.% uranium for a 2-hr nonultrasonic control. Fissium pin dissolution in molten cadmium gave an equilibrium concentration of 2.34 wt.% uranium after 2-hr ultrasonic treatment. Uranium oxide (U_3O_8) reduction—dissolution in the ultrasonic treatment furnace resulted in a 0.4 wt.% dissolved 2-hr concentration of uranium in the molten cadmium in contrast with a 0.013 wt.% control. Ultrasonic Metal and Ceramic Powder Processing. Ultrasonic energy, applied during the extrusion of ceramic powders, produced significant improvements to the process and the product. Ultrasonic die activation resulted in substantial load reductions and concomitant increases in extrusion rates while cylinder activation was relatively ineffective. Ultrasonically extruded test pieces, when sintered, demonstrated improved physical properties compared to nonactivated controls. The feasibility of using ultrasonic vibratory compaction to produce more compact reactor fuel rods is being investigated with alumina powder as a simulant for uranium oxide. Rods with approximately 90% of theoretical density were produced in contrast to low density produced by either 40-ton tamping or 60-cycle vibrating. Ultrasonic Instrumentation. Preliminary motional impedance experiments indicate a critical area of measurement in glass-bead slurries from 0 to 200 g/l. Since very little variation in the mean diameter of the motional loops was obtained at higher concentrations, further study is in process to increase sensitivity. (auth)

27261 (NYO-2574) APPLICATIONS OF ULTRASONIC ENERGY. TASK 1: ULTRASONIC CHEMICAL PROCESSING. TASK 2: ULTRASONIC METAL AND CERAMIC POWDER PROCESSING. TASK 3: ULTRASONIC INSTRUMENTATION. Progress Report No. 20 Covering Period February 1, 1960 to March 31, 1960. (Aeroprojects, Inc., West Chester, Penna.). Apr. 1960. Contract AT(30-1)-1836. 27p.

27262 (RM-2641(RAND)) A STUDY OF THE FEASIBILITY OF DETECTING NUCLEAR EXPLOSIONS BY MEANS OF ANTINEUTRINOS. R. O. Hundley (RAND Corp., Santa Monica, Calif.). Dec. 19, 1960. Contract AF 49 (638)-700. 45p. (AD-252,753)

Considerations are given for the possibility of using the antineutrino flux from a nuclear explosion as a means of detecting the explosion. The basic detection process, the Reines-Cowan reaction, is described, and the flux of antineutrinos from fission explosions of various yields is calculated. The antineutrino backgrounds to be expected from the interior of the earth and from extraterrestrial sources are calculated. Performance characteristics are evaluated for detectors of various sizes. It is found that for the largest detector considered, of the order of 10^9 cu ft, the maximum detection range for a 1-kT explosion is of the order of 100 km, and for a 100-kT explosion it is of the order of 1000 km. The results indicate that the method is not feasible. (auth)

27263 (SRIA-31) HIGH TEMPERATURE HEAT UTILIZATION IN INDUSTRY. F. Alan Ferguson, Leland H. Towle, and Richard R. Tarrice (Stanford Research Inst., Menlo Park, Calif.). Apr. 1961. Contract AT(04-3)-115. 330p.

A study was made to determine where, in what manner, and to what extent high temperature heat (HTH) is used in industry. Through analysis of HTH utilization in 10 carefully selected and representative product areas, the market and the technical, operational, and economic factors associated with HTH facilities and processes are described. Energy in industry, products and industries that require HTH, information on selected HTH operations, and areas of potentially large HTH consumption are discussed. (M.C.G.)

27264 (TID-3760) INFORMAL LISTING OF BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Bibliographies Issued or in Progress During the Period June–July 1961. (Office of Technical Information Extension, AEC). 35p.

A total of 223 bibliographies which are of interest to the Atomic Energy Program are listed in two parts, those issued and those in preparation. The references are arranged by issuing agency, and an author and subject index is included. (D.L.C.)

27265 (TID-4025(1st Rev., Pt.II)) TRANSLATION TITLE LIST AND CROSS REFERENCE GUIDE. PART II. SUBJECT INDEX. (Office of Technical Information Extension, AEC). June 1961. 175p.

The subject index for Part I, which was previously abstracted in NSA, Vol. 16, no. 20484, is given. (P.C.H.)

27266 (UCRL-6541) THE HISTORY OF ELECTRON-BEAM TECHNOLOGY. Rointan F. Bunshah (California. Univ., Livermore. Lawrence Radiation Lab.). July 24, 1961. Contract W-7405-eng-48. 32p.

This is Chapter I in a book entitled, "Introduction to Electron Beam Technology," editor, Dr. R. Bakish.

The past five years have witnessed a sudden outburst of industrial-size devices where electron beams are used for melting and welding of metals, recording, and various other processes. The growth of the basic science of electron beams over more than three-hundred years is traced, as well as the very recent history of the industrial applications. (auth)

27267 (AEC-tr-4541) THE ANALYSIS OF ACCURACY OF SORTING OF PARTS. Vladimir Klega. Translated from Strojirenstvi, 5: 219-21(1955). 10p.

The analysis includes an examination micrometer measurement accuracy, method of computing good parts fractions, and procedures for sorting. Deficiencies of present methods of sorting are noted and conclusions are given. (J.R.D.)

27268 PROPULSION REQUIREMENTS FOR CONTROLLABLE SATELLITES. Theodore N. Edelbaum (United Aircraft Corp., East Hartford, Conn.). ARS (Am. Rocket Soc.) J., 31: 1079-89(Aug. 1961).

Propulsion requirements are determined for several controllable satellite missions. High thrust propulsion systems such as chemical rockets and low thrust propulsion systems such as ion rockets are considered. Rendezvous missions are treated by determining minimum fuel maneuvers for small, simultaneous changes in the elements of quasi-circular orbits. Orbit transfer missions are treated by determining minimum fuel maneuvers for large changes in the elements of circular orbits. Orbit maintenance missions are treated by determining the propulsion necessary to cancel perturbations due to the atmosphere, the Earth's bulge, and the sun and moon. A closed-form analytic solution is found for the optimum low thrust transfer between inclined circular orbits of different radii. (auth)

27269 EXPERIMENTAL PERFORMANCE OF A PULSED GAS ENTRY COAXIAL PLASMA ACCELERATOR. P. Gloersen, B. Gorowitz, and W. Palm (General Electric Co., Philadelphia). ARS (Am. Rocket Soc.) J., 31: 1158-61 (Aug. 1961).

The performance of the plasma accelerator is evaluated by several experimental techniques. Impulse, kinetic energy, specific impulse, mass flow, and propellant species are investigated for single pulse operation of the accelerator fired into an oversize test chamber pumped down to a pressure of 10^{-6} mm Hg. Kerr cell photography of the luminous plasma exhaust indicate a high ratio of unidirectional kinetic energy to thermal energy in the plasma exhaust, as demonstrated by the small amount of lateral spreading of the plasma in the test chamber. Calorimeter measurements indicate that at least 25% of the energy originally stored in the capacitor (4500j) appears as unidirectional kinetic energy in the plasma exhaust. Rotating mirror camera records show that initial portions of the plasma emanate at a specific impulse as high as 25,000 sec, and that subsequent portions emanate at a specific impulse of 6000 sec. (auth)

27270 A PRELIMINARY STUDY OF THERMONUCLEAR ROCKET PROPULSION. J. Reece Roth (Cornell Univ., Ithaca, N. Y.). J. Brit. Interplanet. Soc., 18: 99-108(May-June 1961).

The feasibility of applying controlled thermonuclear power to rocket propulsion is investigated. Such application is shown to be possible within the existing framework of knowledge of thermonuclear processes. The limiting values of reaction temperature, particle density, plasma volume, and power output are derived from theoretical and practical considerations. Relationships are derived which predict the size, mass, thrust, specific impulse, and mass flow of thermonuclear rocket engines. All parameters of interest are calculated for two hypothetical thermonuclear rocket engines, the smaller of which operates near the minimum practical power output, and the larger of which operates at the maximum practicable power density. It is shown that thermonuclear rockets cannot operate in a planetary atmosphere, and that their thrust-to-mass ratio must necessarily be of the order of 10^{-4}. The advantages and limitations of thermonuclear rocket propulsion are discussed, and it is examined as a possible means of interstellar flight. (auth)

27271 INDEX TO THE ANNUAL REPORT TO CONGRESS FOR 1960. Major Activities in the Atomic Energy Programs, January 1960–December 1960. (Atomic Energy Commission, Washington, D. C.). 1961. 44p. Charge $0.20(GPO).

The index supplements a cumulative index to 25 semiannual reports previously issued, and the index to the Annual Report to Congress for 1959. Both author and subject indexes are included. (P.C.H.)

27272 ADVANCED PROPULSION SYSTEMS. Proceedings of a Symposium held in Los Angeles, California, December 11-13, 1957. Morton Alperin and George P. Sutton, eds. International Series on Aeronautical Sciences and Space Flight. Division IX. Symposia. Volume 2. New York, Pergamon Press, 1959. 246p. $6.00.

Eighteen papers are presented, covering such topics as ion and plasma propulsion systems, direct conversion, electrostatic and MHD generators, rocket propellants (liquid, metallic, metallic compound, and free radical), electric equipment, and propulsion system considerations. Eleven of the papers are abstracted separately. (T.F.H.)

27273 ION PROPULSION SYSTEMS. S. Naiditch (Electro-Optical Systems, Inc., Pasadena, Calif.). p.1-32 of "Advanced Propulsion Systems." New York, Pergamon Press, 1959.

In order to deduce ion source requirements, analyses of the over-all performance of a rocket using a nuclear fission power supply and an ion propellant are made. Based on these analyses, minimal requirements are set for the ion source, the acceleration system, and the power system. Existing ion sources are examined in terms of these requirements, and are generally found to be inadequate for ion propulsion. (auth)

27274 EXPERIMENTAL STUDIES ON THE THRUST FROM A CONTINUOUS PLASMA JET. Gordon Cann, Adriano Ducati, and Vernon Blackman (Giannini Research Lab., Santa Ana, Calif.). p.33-41 of "Advanced Propulsion Systems." New York, Pergamon Press, 1959.

An experimental study of the thrust characteristics of a continuous, high-pressure, electrically heated jet is carried out. Argon and helium are used as working fluids. Equilibrium stagnation temperatures for the two gases vary from 5000 to 15,000°K with exit pressures of one atm. At these temperatures real gas effects become important in the analysis of the experiments. For instance, the measurements indicate a degree of ionization between about 0.5 and 15 per cent, depending on the time available for the gas to reach thermodynamic equilibrium. The power input in the gas is measured directly and the fraction of this power in random motion of the particles (temperature), directed motion (thrust), and ionization is determined as a function of gas mass flow rate and chamber pressure. Original measured values of specific impulse are low by a factor of two or three when compared with expected values using real gas thermodynamics. When elongated nozzles are used to confine the jet, the values of the specific impulse were much larger and, within experimental error, equal to the calculated value. This behavior originally observed is attributed to the extreme thermal non-equilibrium that exists in the jet as it issues from the orifice. With the final configuration, specific impulses as high as 600 sec are obtained and it is believed that values as high as 1000 sec can readily be produced with helium. (auth)

27275 THE ION ROCKET ENGINE. Robert H. Boden (North American Aviation, Inc., Canoga Park, Calif.). p.43-70 of "Advanced Propulsion Systems." New York, Pergamon Press, 1959.

The significant design parameters of an ion propellant rocket engine are developed in terms of three independent parameters. These parameters are the ratio of the acceleration voltage to atomic or molecular weight of the propellant, gross weight of the vehicle, and thrust-to-weight ratio. Recommendations are presented for study of ion thrust chambers, power generation systems, and propellants. (auth)

27276 COMPARISON OF PROPULSION SYSTEMS: SOLAR HEATING, ARC-THERMODYNAMICS AND ARC-MAGNETOHYDRODYNAMICS. Krafft A. Ehricke. p.71-104 of "Advanced Propulsion Systems." New York, Pergamon Press, 1959.

The physics and technology of energy transfer to gases by means of solar radiation and electric arcs are discussed. The simpler arc-thermodynamic system produces a highly dissociated gas. In the arc-magnetohydrodynamic system a plasma is produced, i.e., an electrically conducting gas which can be subjected to electromagnetic acceleration in addition to thermodynamic acceleration. A com-

parison of the three systems is presented on the basis of energy requirement, efficiency, specific impulse, complexity of operation, and thrust-to-weight ratio. It is shown that the solar heating system has the highest systems efficiency of energy conversion (about 0.5 for the solar drive against 0.1 to 0.05 for the others but the lowest specific impulse (600 to 800 sec), although the value is two to three times as high as that of chemical rockets. The arc-thermodynamic system essentially produces free radicals at the rate at which they are recombined in the nozzle. Depending on the fluid used, the resulting specific impulse lies between 900 and about 1500 sec for hydrogen. The specific impulse of arc-magnetohydrodynamic systems can be higher by as much as two orders of magnitude, depending upon the degree of ionization and the energy of the accelerating electric field. In practice, specific impulses of 3000 to 5000 sec appear to be an acceptable compromise. In view of the low efficiency of the arc systems, the only attractive energy source is the nuclear pile. With the present method of generating electric energy (turbine-generator) the thrust specific weight of the arc propulsion systems becomes very large, hence, their thrust-to-weight ratio becomes quite small (about 10^{-4}g compared to 10^{-3}g for the solar heating system). Thus, all three propulsion systems can be considered for interorbital operations only. (auth)

27277 THRUST FROM PLASMA. Winston H. Bostick (Stevens Inst. of Tech., Hoboken, N. J.). p.105-14 of "Advanced Propulsion Systems." New York, Pergamon Press, 1959.

Suggestions are presented for five methods of obtaining thrust from plasma. The methods include a button type motor, a series type (analogous to a series wound electric motor), a combination series-shunt plasma motor with externally excited magnetic field (analogous to a series-shunt wound motor), a rotary shunt plasma motor (a variation of the shunt motor), and a barrage of button motors. Electrical circuit parameters including back emf, input voltage, load impedance, capacity and inductance, are derived and summarized numerically. A method of measuring minute thrusts developed by small laboratory type motors is presented. Experimental problems and the efficiency of the plasma motors are discussed. (auth)

27278 POTENTIAL AIRCRAFT APPLICATIONS OF CLOSED GAS CYCLE NUCLEAR POWER PLANTS. Rolf D. Buhler (Plasmadyne Corp., Santa Ana, Calif.) and Peter J. Gingo. p.117-34 of "Advanced Propulsion Systems." New York, Pergamon Press, 1959.

Closed gas-cycle nuclear power plants for aircraft applications are discussed in view of recent advances in refractory metals and ceramic fuel element technology. With high-pressure helium as the primary loop working fluid, the chief advantages of the closed-cycle gas-cooled system are its compact reactor, high cycle efficiency, freedom from corrosion, and high physical and nuclear stability of the working fluid. Heat exchanger sizes, weights, and tightness, together with the possibility of fission product leakage into the helium, are considered the most severe problems. Neither the size, weight, nor performance of the helium turbo-machinery should pose serious difficulties. The performance of a subsonic cruise–supersonic dash airplane, with chemical fuel augmentation, is calculated using material temperatures compatible with present technology. Two other airplanes, which were all-supersonic and which used a nuclear power plant system during their entire mission, are studied. A preliminary study of the possible space vehicle applications of closed gas-cycle systems is discussed. (auth)

27279 DIRECT POWER CONVERSION: PART I. GENERAL COMMENTS. J. H. Huth (RAND Corp., Santa Monica, Calif.). p.145-9 of "Advanced Propulsion Systems." New York, Pergamon Press, 1959.

Some of the motivations for interest in direct power conversion (conversion of any other form of energy to electricity in one step) are reviewed, from the point of view of providing energy for space vehicles. The motivations suggested include: the possibility of weight savings through the elimination of intermediate conversion equipment or increased radiator temperatures; increased reliability through simplicity; and direct generation of voltages suited to ionic propulsion schemes. A discussion of a few of the many proposed direct-conversion devices is given. Solar cells, fuel cells, and thermocouples are discussed. (auth)

27280 DIRECT POWER CONVERSION. PART II. THE FISSION-ELECTRIC REACTOR. George Safonov (RAND Corp., Santa Monica, Calif.). p.151-9 of "Advanced Propulsion Systems." New York, Pergamon Press, 1959.

The idea of recharging an electrostatic generator by means of virgin-born fission fragments is considered, in the light of the "cavity reactor" concept. Basic principles are reviewed. A particular low temperature reactor design, the dimensions of which appear practical for terrestrial operation but are most probably excessive for non-terrestrial operations, is discussed. Possibilities for refueling and for achieving electrical efficiencies greater than the nominal 5 per cent indicated by the illustrative reactor design are discussed. Applications related to ground based machines are discussed, since these may become of interest with the advent of lighter designs suitable for space applications. (auth)

27281 ELECTROSTATIC GENERATORS. A. John Gale (High Voltage Engineering Corp., Burlington, Mass.). p.161-71 of "Advanced Propulsion Systems." New York, Pergamon Press, 1959.

The power/weight ratio of electrostatic generators is appraised in a space flight environment. Under such "weightless" and vacuum conditions, electrostatic machinery may have a power/mass ratio more favorable than that of electromagnetic equipment of equal output. Because electrostatic generators are also suited to the moderately high potentials required by ion propulsion, transformer equipment and perhaps even rectifier equipment may be avoided. The principles of electrostatic power generation and design considerations for very high power machines are discussed. (auth)

27282 MAGNETOHYDRODYNAMIC GENERATORS AND PROPULSIVE DEVICES. Richard J. Rosa (Avco Research Labs., Lawrence, Mass.). p.175-7 of "Advanced Propulsion Systems." New York, Pergamon Press, 1959.

Magnetohydrodynamic devices are discussed from the viewpoints of their capability for producing high velocity gases, which can result in thrust of large magnitude at any altitude, and of their property that electric power can be extracted from their flow of ionized gases. Capabilities and weights of the devices are indicated. A proposed generator of high specific power is suggested. Engineering difficulties encountered in building such a generator are summarized. (auth)

27283 HUMAN HAZARDS OF SPACE FLIGHT. Homer J. Stewart (California Inst. of Tech., Pasadena). p.199-202 of "Advanced Propulsion Systems." New York, Pergamon Press, 1959.

From the propulsion standpoint, the question of human hazards of space flight is largely equivalent to the question of reliability. Two separate phases of operation are dis-

cussed. The first phase concerns the vehicle used to launch the pilot into space, and the second phase concerns the propulsion requirements to return him to the earth. The most significant difference between these two phases is connected with the requirement for the second phase to operate after an extended period in a free space environment. For the launching phase the requirement for reliability is not different in kind, although it is probably quantitatively more restrictive, than the military requirements for weapon use. This requirement may well be satisfied only with rocket systems having performance somewhat inferior to that used for weapon systems. It appears that a compromise solution based on the use of high-energy liquid propellants may be the preferred solution. For the return phase of a space mission, the thermal and meteoritic environments are most apt to influence design specifications. The thermal environment makes it unlikely that liquefied gases would be the preferred propellants. The problems associated with possible meteorite impacts make it unlikely that thermochemically unstable compounds such as hydrazine or hydrogen peroxide, or most of the solid propellants, would be preferred for this application. (auth)

BIOLOGY AND MEDICINE

General and Miscellaneous

27284 (AD-253643) INCREASING THE ACCEPTANCE OF IRRADIATED MEAT AND MEAT PRODUCTS BY SELECTED TREATMENTS BEFORE, DURING AND FOLLOWING IRRADIATION. Report No. 16 (Final), December 28, 1956–September 1, 1960. H. W. Schultz (Oregon. Agricultural Experiment Station, Corvallis). Contract DA19-129-qm-836. 113p.

Methods were investigated for increasing the aceptance of irradiated meat and meat products by selected treatments before, during, and following irradiation. Irradiated chili con carne, beef stew, and noodles and beef were scored much lower than their thermally processed counterparts. Sterilizing doses of radiation destroyed 99% of the antibiotics tested. The use of oxytetracycline with pork cuts provided an additional 2 days of storage life at 50°F. Certain liquid smokes and "charcosalt" added to beef either before or after radiation resulted in a definite improvement in the flavor of beef. Continuous purging of the headspace contents with N_2, CO_2, or air during radiation of beef steaks failed to improve the flavor when compared to static treatment with these same gases. Pork and beef roasts preheated to temperatures between 160 and 190°F and then irradiated at 1.9 and 2.8 megarad could be held at 72°F for 250 days without deleterious changes in flavor or breakdown of the protein. It was necessary to pre-heat meat to at least 160°F. Increasing the pre-irradiation heat treatment, a reduction in the radiation dosage, and reducing the storage temperature all contributed to a general retardation of proteolytic breakdown of radiation sterilized beef. Aging beef for up to 96 hr followed by radiation did not reveal significant differences in tenderness from that of the non-irradiated beef. The addition of salt improved the water holding capacity of the beef and provided a desirable degree of moistness. (M.C.G.)

27285 (AF-SAM-61-75) INHIBITORY ACTION OF DITHIOCARBAMATES ON ENZYMES OF ANIMAL TISSUES. Kenneth P. DuBois, Ann B. Raymund, and Bernard E. Hietbrink (Chicago. Univ. Air Force Radiation Lab.). Feb. 28, 1961. 13p.

Issued by School of Aerospace Medicine, Brooks AFB, Tex.

A study of the effects of derivatives of dithiocarbamic acid was conducted in an attempt to obtain information on the biochemical mechanisms responsible for their toxicity and their radioprotective action. The compounds employed were sodium diethyldithiocarbamate, diethylammonium diethyldithiocarbamate, dimethylammonium dimethyldithiocarbamate, and bis(dimethyldithiocarbamyl) disulfide. Attention was focused on the actions of these compounds on the oxidative phase of intermediary carbohydrate metabolism. All of the compounds were effective inhibitors of the tricarboxylic acid cycle of animal tissues in vitro as evidenced by inhibition of oxygen consumption, citrate synthesis, pyruvic dehydrogenase, alpha-ketoglutarate oxidase, and succinic dehydrogenase. The salts of dithiocarbamic acid were effective inhibitors of these enzymatic reactions in vivo, but the disulfide, which lacks radioprotective activity, did not inhibit these reactions in the intact animal. The salts of dithiocarbamic acid also rapidly reduced cytochrome c and inhibited tyrosinase activity in vitro. The results suggest that the acute mammalian toxicity of the dithiocarbamates is the result of their strong inhibitory action on enzymes that require sulfhydryl groups for activity. (auth)

27286 (BNL-649) INSIDE THE PROTEIN MOLECULE. Brookhaven Lecture Series No. 3. C. H. W. Hirs (Brookhaven National Lab., Upton, N. Y.). Jan. 11, 1961. 33p.

Studies of the structures of proteins are summarized. Examples were selected from among the viruses in order to introduce the idea that proteins are important biologically in determining both morphology and function. The relative amounts of the different amino acids produced when a protein is completely broken down by hydrolysis are outlined. The number of polypeptide chains in the protein molecules and the sequence of the amino acid residues in each of the chains are discussed. The forces resulting from the backbone hydrogen bond are described. The differences in α and β-forms of polypeptide chains are summarized. The structure picture developed by extending the Fourier analysis with myoglobin almost to the limits of the diffraction pattern is described. (M.C.G.)

27287 (HW-69500) HANFORD BIOLOGY RESEARCH ANNUAL REPORT FOR 1960. F. P. Hungate and E. G. Swezea, eds. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 10, 1961. Contract AT(45-1)-1350. 195p.

Separate abstracts were prepared for 43 sections of this report. (C.H.)

27288 (HW-69500(p.28-30)) FACILITIES FOR MEASUREMENTS OF RADIONUCLIDES IN LARGE ANIMALS. A. C. Case and J. R. McKenney (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Facilities for measuring the radionuclide content of large, intact animals are described. The shielded steel structure will contain two 1-mm by 2-in. NaI crystals (in shielded horizontal probes) for soft gamma and bremsstrahlung measurements, and three 2-in. by 2-in. NaI crystals (in three shielded probes) for γ emitters. Large animals will be placed on a platform which will be motor-driven past the detector probes. (auth)

27289 (HW-69500(p.144-6)) BLOOD CONSTITUENTS IN PITMAN-MOORE, PALOUSE, AND HORMEL SWINE. P. L. Hackett and W. J. Clarke, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Data are tabulated on the blood constituents of normal Pitman-Moore, Palouse, and Hormel swine. Comparative data on man are included. (C.H.)

27290 (HW-69500(p.151-5)) DISPERSION OF GAMMA EMITTERS IN MARINE ORGANISMS NEAR THE MOUTH OF THE COLUMBIA RIVER. D. G. Watson, J. J. Davis, and W. C. Hanson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Gamma-emitting radioelements have been detected and measured in marine plants and animals collected from the coasts of Washington, Oregon, and Alaska during 1959 and 1960. Some of these radioelements occurred in nearly all samples from all collecting sites, others were found only in specimens from near the mouth of the Columbia River. (auth)

27291 (HW-69500(p.156-9)) SALMON SPAWNING IN THE VICINITY OF HAPO–1960. D. G. Watson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The salmon nest counts in the section of the Columbia River from Richland to Priest Rapids, Washington, for 1960 were approximately the same as those for 1959. Fluctuations in the local population are compared with the yearly salmon counts at Bonneville and McNary Dams. Rapid change in river level due to dams upstream from HAPO left some salmon nests completely out of water. (auth)

27292 (HW-69500(p.160-5)) STUDIES ON THE FISH DISEASE CHONDROCOCCUS COLUMNARIS. M. P. Fujihara and P. A. Olson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Young salmon and rainbow trout showed increased resistance to infection by the myxobacterium Chondrococcus columnaris as size and age progressed. Increased size also was related to a longer lag period between exposure and death. Temperature effects on survival differed between organisms suspended in sterile river water and in sterile river mud. (auth)

27293 (HW-69500(p.166-72)) BANDING STUDIES ON GULLS AND GEESE ON THE HANFORD RESERVATION. W. C. Hanson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Ring-billed and California gulls from separate colonies within the Hanford Reservation were banded. Recovered bands show a mingling of the colonies and indicate migration patterns into Canada and Mexico. Returns of 270 out of 1418 bands placed on Canada geese during a nine-year period illustrate dispersion along definite flyways which are described. (auth)

27294 (NP-10510) MECHANISM OF THE HEMORRHAGIC PHENOMENON PRODUCED IN MALE RATS BY FEEDING OF IRRADIATED BEEF. Progress Report No. 5, March 15, 1960 to September 15, 1960. Susan J. Mellette (Medical Coll. of Virginia, Richmond). Contract DA-49-007-MD-951. 39p.

Studies of the difference between male and female animals in susceptibility to hypoprothrombinemia and hemorrhage were continued with animals fed irradiated beef diets and extended to include other diets and also the administration of anticoagulant drugs. Sex differences similar to those of animals fed beef diets are demonstrated in rats receiving a commercial stock diet. A considerable difference was found between two commercial diets in terms of the maintenance of normal coagulation factors. Male animals in several age ranges were found to be more sensitive to the effect of large single doses of the anticoagulant warfarin sodium (coumadin) than are females. Pre-treatment with estradiol benzoate improved the prothrombin levels and the survival of male rats receiving the anticoagulant. A greater mortality after coumadin occurred in females pre-treated with androgens. A_cG levels decreased during continued administration of testosterone to females fed stock as well as beef diets. Strain differences in prothrombin were also noted, and estrogenic activity was demonstrated for both menadione and K_1. (P.C.H.)

27295 (NP-10593) REPORT ON THE WORK OF THE INSTITUTE OF NUCLEAR SCIENCES [NO.] 3, March 1, 1960–February 28, 1961. (New Zealand. Dept. of Scientific and Industrial Research. Div. of Nuclear Sciences, Lower Hutt). Mar. 1961. 86p. (A.E.C.-65)

Plans for the construction of the first stage of the Institute were finished. The buildings to be constructed are the accelerator block, a physical and chemical laboratory block, a small services block, and an administrative block housing in addition the library, lecture hall, and cafeteria. The 3-Mev proton-electron Van de Graaff Accelerator was constructed and tested. The accuracy of tritium age measurements was determined. High-temperature G-M tubes suitable for the well-logging project at Wairakei were developed. Through a study of the activity in the rings of an 800 yr old New Zealand kauri, a steady increase in the C^{14} activity over the past 800 yr was observed. Cosmic ray telescopes were put into operation to measure diurnal variations. A tree-ring densitometer was developed. Equipment is under construction for use with the accelerator. (M.C.G.)

27296 (TID-13121) EXTERNAL LOCALIZATION OF BRAIN-TUMOR EMPLOYING POSITRON-EMITTING ISOTOPES. Progress Report, July 1, 1960 through June 1, 1961. (Massachusetts. General Hospital. Neurosurgical Service, Boston and Massachusetts. General Hospital. Physics Research Lab., Boston). June 15, 1961. Contract AT(30-1)-1242. 62p.

Studies are being made of the application of positron-emitting isotopes to the detection and localization of intracranial lesions, particularly by the use of external detectors and automatic scanning techniques. Instrumentation development was concentrated primarily on the positron camera. Work was carried out on the system involving multiple phototubes viewing a single large crystal. An alternative method of image portrayal using pulsed image intensifier tubes was also investigated. Isotope studies were continued, searching for substitutes for As^{74}. The Ga^{68} separation procedure was standardized. Biological studies consisted primarily of an intensive investigation of the uptake of compounds of copper in mouse tumors. During the year, 665 scans were performed. (M.C.G.)

27297 (TID-13360) PROGRESS REPORT [ON PHYSIOLOGICAL CHEMISTRY FOR] PERIOD JUNE 1, 1960–JUNE 1, 1961. W. D. Armstrong and Leon Singer (Minnesota. Univ., Minneapolis). Contract AT(11-1)838. 14p.

The comparative movements of Ca^{45}, F^{18}, and Sr^{85} from labeled blood to bone and, in other experiments, from a radioactive bone to blood were investigated by perfusion of the isolated limb of the dog. Investigations of the removal of Sr^{85} from milk were carried out involving agitation of solid absorbers with radioactive milk and refinements in the column technique by which milk is percolated through columns of ground absorber material. The influences of contact time on the removal of Sr^{85} from milk and on the composition of milk were also investigated. Investigations were made of the movement of Ca^{45}, Sr^{85}, and water-t from the contents of the small intestine in rats. The distribution of Ca^{45} and Sr^{85} in normal and nephrectomized rats was determined. (M.C.G.)

27298 (AEC-tr-4759) EXPERIMENTAL INVESTIGATIONS INTO THE IMMUNOLOGIC THEORY OF SILICOSIS. W. Licht. Translated for Los Alamos Scientific Lab. from Arch. Gewerbepathol. Gewerbehyg., 18: 327-36(1960). 13p.

An attempt was made to demonstrate the presence of antibodies in silicosis sufferers by assuming that the generation of the "silicosis antigen" could be adequately reproduced in the test tube by simple adsorption processes. For this purpose healthy lung tissue, after being cleansed of blood and serum remnants at high rotatory speed, was homogenized with a physiological solution of common salt. Following analyses, the lung homogenate was brought together with silica particles and kept in the incubator for 12 hr at 27°C to test the adsorption. The same antigens were tested by the electrophoresis migration method. The results obtained thus far indicated that serum gamma

globulin is present as an inherent part of the silicosis hyalin of man. The tests made in order to determine whether within this context the gamma globulins act as antibodies did not lead to any conclusive results. (M.C.G.)

27299 (NP-tr-706) THE HYGIENIC CHARACTERISTICS OF POTATOES IRRADIATED WITH RADIOACTIVE COBALT FOR THE ARREST OF SPROUTING. Defence Research Board Translation No. 54. L. A. Okuneva. Translated by Geoffrey Phillips from Voprosy Pitaniya, 17: No. 5, 49-53(1958). 7p.

Also issued as French report CEA-tr-R-893.

This paper was previously abstracted from the original language and appears in NSA, Volume 15, as Abstract No. 4210.

27300 THE DILUTION OF A TRACER IN A SYSTEM OF CAVITIES IN SERIES TRAVERSED BY A PULSING FLUID. APPLICATION TO CARDIAC HEMODYNAMICS. Claude Kellershohn, Pierre de Vernejoul, and Bernard Delaloye (Commissariat à l'Énergie Atomique, Paris). Compt. rend., 252: 1394-6(Feb. 27, 1961). (CEA-1959). (In French)

Considering a consecutive series of cavities the volume of which can vary periodically with time, traversed by a pulsing fluid with the same period, the relations expressing at each moment the amount of tracer in each cavity after the initial injection into the first are given. From the results obtained, the experimental curve showing the variation with time of cardiac radioactivity after rapid injection of a radioactive tracer immediately above the heart cavities was interpreted. (auth)

27301 NOTES ON BIRD NESTS FOUND IN A DESERT SHRUB COMMUNITY FOLLOWING NUCLEAR DETONATIONS. W. H. Rickard (General Electric Co., Richland, Wash.). Condor, 63: 265-6(May-June 1961).

The occurrences of bird nests in relation to the gross influences of nuclear detonations, which occurred prior to September 2, 1957, on the vegetation of a desert shrub community are reported. (M.C.G.)

27302 UPTAKE OF RADIOACTIVE IRON (Fe^{59}) BY RAT BONE MARROW MEGAKARYOCYTE IN VIVO. S. K. Brahma, A. Bose, and S. Bose (Chittaranjan National Cancer Research Centre, Calcutta). Naturwissenschaften, 48: 437(1961). (In German)

A study of the uptake of Fe^{59} by bone marrow megakaryocytes was made using albino rats. Each animal received intraperitoneal injections of Fe^{59}. After 48 hours the femora were removed, and random sections 5 μ thick were used for autoradiographic exposures. Good uptake of the Fe^{59} was found. (J.S.R.)

27303 UNUSUAL BIOPHYSICAL PROPERTIES OF THE TEMPERATE PHASE α. A. Celano (Istituto Nazionale di Fisica Nucleare, Naples and Università, Naples), S. Aurisicchio, A. Coppo, P. Donino, and F. Graziosi. Nuovo cimento (10), 18: Suppl. No. 2, 190-6(1960). (In English)

A study of the temperate bacteriophage α using a radioautography technique is described. (T.R.H.)

27304 SOVIET CELLULAR BIOPHYSICS 1950–1960. Richard B. Setlow and Jane K. Setlow (Yale Univ., New Haven). Quart. Rev. Biol., 36: 1-49(Mar. 1961).

The Soviet biophysical literature is subdivided into sections on techniques, effects of ionizing radiation, effects of light radiation, photosynthesis, effects of ultrasonics, paramagnetic resonance, microorganisms, viruses, cell structure, proteins, nucleic acids, and muscle, nerve, vision, and taste. A bibliography of 520 entries is included. (P.C.H.)

27305 FOLIAR RETENTION OF STRONTIUM-90 BY WHEAT. Ronald G. Menzel, Donald L. Myhre, and Howard Roberts, Jr. (U. S. Agricultural Research Service, Beltsville, Md.). Science, 134: 559-60(Aug. 25, 1961).

Wheat harvested from the University of Maryland Agronomy Farm in June 1959 contained 20 to 50 micro-microcuries of strontium-90 per kilogram of grain. More than 90% of the strontium-90 came from deposition on aboveground plant parts, and less than 10% was taken up through the soil. About 1 to 2% of the strontium-90 fallout during the time the heads were exposed was retained in the grain. (auth)

27306 DETERMINATION OF INTERNAL WATER STATUS OF PLANTS BY BETA RAY GAUGING. H. J. Mederski (Ohio Agricultural Experiment Station, Wooster). Soil Sci., 92: 143-6(Aug. 1961).

Changes in the water status in leaves of intact plants were determined with a beta-ray gauge. A C^{14} source of beta radiation was placed on one side of a leaf and a thin window Geiger tube on the other side. Beta radiation traversing the leaf thickness was closely related to the relative turgidity of the leaf. The technique shows promise as a non-destructive, sensitive method of continuously monitoring the internal water status of intact plants. (auth)

27307 MAIN ACHIEVEMENTS OF AGRICULTURAL SCIENCE IN THE USSR (Osnovnye Dostizheniya Sel'skokhozyaistvennoi Nauki v SSSR). D. D. Brezhnev and I. A. Minkevich. 125p. Translated from a Publication of the State Publishing House for Agricultural Literature, Moscow, 1958. (OTS-60-51199; PST Cat. No. 160). $1.25(OTS).

The history of developments in agricultural science in the USSR is reviewed. Topics discussed include land cultivation, plant breeding, fodder production, weed control, research on the agronomic properties of soil and its cultivation, the protection of plants against pests and diseases, livestock raising and veterinary science, mechanization and electrification of agriculture, hydraulic engineering and land reclamation, and the economics and organization of agriculture. The use of isotopes and radiation in agricultural science has progressed from 10 institutes in 1952 to 100 scientific and training institutes in 1957. (C.H.)

27308 ISOTOPIC TRACERS. A Theoretical and Practical Manual for Biological Students and Research Workers. Second Edition. G. E. Francis, W. Mulligan, and A. Wormall. London, University of London, 1959. 544p.

A theoretical and practical manual on the use of isotopes in biochemical and physiological investigations is presented. The manual gives up-to-date and reliable data with regard to the physical characteristics of radioactive isotopes and radiations, the types of apparatus and equipment available, and the experimental techniques used in the biological isotopic tracer field. (N.W.R.)

27309 APPLICATIONS OF RADIOISOTOPES AND RADIATION IN THE LIFE SCIENCES. Hearings before the Subcommittee on Research, Development, and Radiation of the Joint Committee on Atomic Energy, Congress of the United States, Eighty-Seventh Congress, First Session, March 27, 28, 29, and 30, 1961. (United States. Congress. Joint Committee on Atomic Energy). 519p. $1.50(GPO).

Separate abstracts have been prepared on 29 statements and papers presented. (C.H.)

27310 [RADIATION IN THE LIFE SCIENCES]. Statement of Dr. C. L. Dunham (U. S. Atomic Energy Commis-

sion, Washington, D. C.). p.4-9 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Developments in applications of nuclear energy and its byproducts in biology and medicine during the past five years are reviewed. Topics discussed include the development and applications of whole-body radiation counters; the labeling of the thymidine molecule with tritium and applications as a tracer in studies on the production and fate of desoxyribonucleic acid; research in terrestrial ecology, the marine sciences, and the fate of radionuclides in man's environment; the mechanisms by which radiation produces genetic and metabolic effects and induces cancer; and the selective uptake of a variety of radioelements by plant roots and leaves, and the movement of these elements in the soil. Educational and training program development and expansion are also reviewed. (C.H.)

27311 [THE USE OF RADIATION AND RADIOISOTOPES IN DENTISTRY AND DENTAL RESEARCH]. Statement of Dr. W. D. Armstrong (Univ. of Minnesota, Minneapolis). p.9-23 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Advances in dental research that have come through the use of radioisotopes are reviewed. Topics discussed include studies on physiological processes in calcified tissues, the transport of substances into and through the teeth, procedures for the evaluation of dental treatment, and studies on the health safety of water fluorination. (C.H.)

27312 [USE OF RADIOISOTOPES AND RADIATION IN THE DIAGNOSIS OF DISEASES]. Statement of C. C. Lushbaugh, M.D. (Los Alamos Scientific Lab., N. Mex.). p.23-47 "Applications of Radioisotopes and Radiation in the Life Sciences."

Design features of whole-body scintillation counters and arm counters are reviewed. Applications are reported in numerous clinical tracer and diagnostic studies. These include excretion rates for I^{131}; studies of cretinism in the new-born infant; hypothyroidism in obese pubescent girls and sterile young women; determinations of the completeness of a thyroidectomy for thyroid cancer and possible recurrence of carcinomas; the relationship of dietary Fe absorption to anemia; studies on blood circulation with Cr^{51}-labeled red cells; studies on Na balance after the administration of $Na^{22}Cl$; studies using Co^{60} as a tracer for fat absorption and vitamin physiology; and measurements of blood clearance of various kinds of labeled dyes and other substances. (C.H.)

27313 [HIGH ENERGY RADIATIONS IN BIOLOGICAL RESEARCH AND THERAPEUTIC INVESTIGATION]. Statement of Cornelius A. Tobias (Univ. of California, Berkeley). p.47-79 of "Applications of Radioisotopes and Radiation in the Life Sciences."

The origins and physical nature of radiations used in diagnosis and therapy of cancer are reviewed. Emphasis is placed on recent developments in deep local radiation therapy. Topics discussed include the use of high energy supervoltage x radiation, γ radiation, and electron sources for direct tumor therapy; the use of 180 Mev protons for the irradiation of metastatic lesions; the development of procedures for indirect radiation therapy using precisely controlled high energy protons or α particles; selective irradiation of the human pituitary gland using either 340 Mev protons or 900 Mev α particles; applications of pituitary α irradiation as a diagnostic tool; applications of pituitary α irradiation in the treatment of advanced diabetes mellitus, acromegaly, and to produce partial lobatomy, the treatment of Parkinson's disease and various kinds of tremors by heavy ion beams; and the possibility of using heavy particle beams of only a few microns in diameter to probe the location, depth, and time dependence of neural functions. (C.H.)

27314 [THE ARGONNE CANCER RESEARCH HOSPITAL OF CHICAGO]. Statement of Dr. Robert J. Hasterlik (Argonne Cancer Research Hospital, Ill.). p.79-146 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Recent advances in the treatment of malignant diseases with various sources of radiation are reviewed. Refinements of radiation therapy, both by external radiation beams or implanted radiation sources, are described. Topics discussed include implantation therapy using Pd^{103} sources for cancer treatment; the insertion of Y^{90} pellets through the nose for destruction of the pituitary gland; and the use of bent electron beams, rotational gamma units, and high-energy x-ray beams in cancer therapy. The production and use of I^{125} for certain clinical and experimental studies are also described. (C.H.)

27315 [THE USE OF ATOMIC ENERGY TO STUDY AGRICULTURAL CHEMICAL RESIDUES]. Statement of Dr. H. L. Haller (U. S. Dept. of Agriculture, Beltsville, Md.). p.147-60 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Uses of atomic energy to study agricultural chemical residues are discussed. Many labeled pesticides have been synthesized, including organic insecticides, fumigants, plant insecticides, inorganic insecticides, fungicides, and herbicides. Labeled chemicals have been found valuable in obtaining residue data needed for the establishment of safe limits or tolerances. It is pointed out that under the Miller amendment to the Federal Food, Drug, and Cosmetic Act tolerances are necessary before pesticides which leave residues on foods can be used. Labeled pesticides are also useful for studies of their mode of action in plants and animals. Radioisotopes have also been used as tags or markers to study the flight habits of insects and the migration of insect larva in soil. Chemical formulas of representative pesticides are presented, and the atoms that have been labeled are indicated. (C.H.)

27316 [SOIL CHEMISTRY AND PLANT NUTRITION]. Statement of Dr. S. R. Olsen (U. S. Dept. of Agriculture, Beltsville, Md.). p.160-8 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Applications of radioisotopes in obtaining basic information on plant nutrition, the behavior of nutrients added to soil, their movements in the soil and subsequent uptake by roots, the functions they serve in the plant, and the relationship of soil water to these processes, are discussed. Studies are described in which P^{32}, C^{14}, or Rb^{86} were used as tracers. (C.H.)

27317 [CONTROL OF INSECT PESTS BY RADIATION STERILIZATION TECHNIQUES]. Statement of L. D. Christenson (U. S. Dept. of Agriculture, Beltsville, Md.). p.169-88 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Insect control by means of radiation sterilization requires the release of sufficient numbers of sterile insects to overcome the reproductive potential of natural populations. Methods for mass production, sterilization, and distribution of insects are described. The effectiveness of the sterilization method of population supression was demonstrated in field trials with the screw-worm fly. A pest formerly costing livestock growers over $20 million a year was eradicated. The method was also used to control melon flies and fruit flies. Sterilization studies with mosquitoes, the pink ball worm, codling moths, corn earworm,

fall armyworm, sugarcane stalk borer, boll weevil, tobacco budworm, sheep blow fly, tsetse fly, and other insects are underway or planned. Radiation may also be useful as a quarantine treatment for insect-infested commodities. Dosages of 10000 to 20000 r were found to destroy the reproductive potential of immature stages of fruit flies in fresh fruit and vegetables. (C.H.)

27318 [THE USE OF ATOMIC ENERGY IN FARM ANIMAL STUDIES]. Statement of Dr. Frederick N. Andrews (Purdue Univ., Lafayette, Ind.). p.188-95 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Uses of atomic energy in farm animal studies include tracer studies of body composition, the use of whole-body counters in the genetic improvement of swine, the evaluation of the effectiveness of nutritional experiments, evaluation of the chemical residue problem, basic growth studies, measurements of radioactive contamination, the quantitative analysis of K, the evaluation of drugs, and the relationship of physical fitness of preadolescent and adolescent males to body composition. (C.H.)

27319 [THE ROLE OF RADIATION IN THE PRODUCTION OF NEW PLANT VARIETIES]. Statement of Dr. Seymour Shapiro (Brookhaven National Lab., Upton, N. Y.). p.195-227 of "Applications of Radioisotopes and Radiation in the Life Sciences."

The role of radiation in the production of new plant varieties is discussed. Irradiation facilities for the exposure of plant materials at Brookhaven and at the University of Tennessee–AEC Laboratory at Oak Ridge, Tennessee, are described. Topics discussed include the effects of radiation on chromosomes and cell division; the production of plant mutations following the exposure of plants, shrubs, and trees to either internal or external irradiation; changes in flower colors after irradiation; increased yields in food crops grown from radioinduced mutants; the development of disease-resistant plants from radioinduced mutants; and the accumulation of new theoretical knowledge in the field of radiation biology, particularly in the fields of radiobotany and radiation genetics. (C.H.)

27320 [THE UT-AEC PLANT AND SEED IRRADIATION PROGRAM]. T. S. Osborne (Univ. of Tennessee, Knoxville). p.227-8 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Botanical studies include irradiations of seeds and plant materials for plant scientists. Since 1956, some 475 specimens have been irradiated and numerous potentially valuable mutations in many crops have resulted. These include mutants for disease resistance in soybeans, tobacco, and tomatoes; early maturity and greatly increased fiber strength in cotton; seedless watermelons, nonvining cucumbers, and dwarfed plants of rice and grain sorghum. Valuable information has been obtained on dose-response in many species, means of controlling the mutational effects of radiation, and factors affecting the radiosensitivity of dormant seed. (C.H.)

27321 [THE USE OF RADIOISOTOPES TO DETERMINE THE DIFFUSION, DISPERSION, AND CIRCULATION OF OCEAN WATERS]. Statement of Dr. Vaughan T. Bowen (Woods Hole Oceanographic Institution, Woods Hole, Mass.). p.234-51 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Applications of radioisotopes in studies on the diffusion, dispersion, and circulation of ocean waters are described. It is pointed out that ocean circulation studies are needed on a world-wide basis if the capacity of the oceans to produce food and changes in weather and climate are to be predicted with greater precision. So far studies have been made with naturally occurring radiocarbon, with naturally occurring radium, and with bomb-test produced tritium, Sr^{90}, Cs^{137}, or mixtures of fission products produced in a nuclear explosion. Studies have been made on direct rates of vertical travel of water and of dissolved materials, and horizontal rates of travel of water below the surface. The effects of vertical movement of ocean waters on the disposal of radioactive wastes in the oceans and on the dilution of fall-out radioactivity are discussed. (C.H.)

27322 [RADIOISOTOPES IN THE STUDY OF THE HYDROLOGIC CYCLE]. Statement of Dr. L. L. Thatcher (U. S. Geological Survey, Washington, D. C.). p.252-65 of "Applications of Radioisotopes and Radiation in the Life Sciences."

The study of the fundamental operation of the hydrologic cycle involves processes of continental and hemispheric dimensions. The evaporation of water from the sea, its transport inland by the prevailing winds, its deposition on land as rain or snow, and its infiltration into the permanent ground water reservoir through recharge areas scattered over hundreds of miles are all processes which require a tool of tremendous scope for their analysis. Tritium is universally present in measurable quantities in all waters deposited by rain within the past 50 years. Tritium is created in nature by cosmic ray bombardment of air molecules at the edge of the stratosphere, and the tritium oxidizes to form a water molecule which is incorporated into the high-altitude clouds and eventually falls as precipitation, thus providing a label to follow the movement of water throughout the hydrologic cycle. The average concentration of tritium of cosmic ray origin in rainfall of the United States was established as 7 tritium units before the value was drastically raised by the explosion of a thermonuclear bomb in 1954. Applications were also made of the new source of tritium in hydrologic research. Tritium produced by cosmic rays, thermonuclear explosions, and nuclear reactors has opened up new possibilities for hydrologic tracer experiments. Applications of tritium described are: studies of rainout in 1958, analysis of basin hydrology, river origins, origin of springs, the development of future water resources, water leakage through solution holes in the bottom of reservoirs, measurements of the rate of movement of water to springs, and estimates of stored ground water pools. Tritium also makes a useful label to trace the movement of radioactive wastes from disposal pits through the soil. Procedures used in the determination of tritium in water are reviewed. (C.H.)

27323 [LIFE IN FRESH AND MARINE WATER]. Statement of Dr. Allyn Seymour (Univ. of Washington, Seattle). p.266-76 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Applications of radioisotopes and radiation in studies of life processes of aquatic organisms are reviewed. Topics discussed include the use of radioisotopes as tracers to study metabolic pathways of specific elements and physiological processes in aquatic organisms; the biological distribution of elements; the feeding habits of shellfish; the effectiveness of fertilizers in improving the productivity of ponds and lakes; the use of C^{14} to estimate the rate of primary productivity in ponds, lakes, bays, and oceans; and the use of tracers to study ecological systems. The ecological study of fall-out radioisotopes represents the greatest effort in ecological studies. Data are included on the distribution of 1954 fall-out in 1959 ecosystems. Contributions of activation analysis and autoradiography in studies of biological systems are also discussed. (C.H.)

27324 [THE STUDY OF BIOCHEMICAL PROCESSES]. Statement of Dr. G. David Novelli (Oak Ridge National Lab., Tenn.). p.277-95 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Recent advances in studies of biochemical processes implemented by the use of radiation and radioisotopes are reviewed. Examples of such studies include the synthesis of proteins, reaction mechanisms involved in metabolism, information contained in the genetic material of cells, the nature of the code in which amino acid sequence is contained in the genetic material, how amino acids are assembled, control mechanisms used by cells to regulate the rate of protein synthesis and growth, degradation reactions, test-tube studies of protein synthesis and gene action, processes involved in the photoreactivation of cells, reaction mechanisms in cell-free systems prepared from x-irradiated cells, and fundamental biochemical studies in both cells and intact animals. (C.H.)

27325 [IMMUNE REACTIONS]. Statement of Dr. Frank J. Dixon (Univ. of Pittsburgh). p.295-303 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Radioisotopes have made new advances possible by affording entirely new methodological approaches to studies of the way in which foreign materials initiate antibody responses, the mechanism of antibody synthesis, their behavior in the body, and the nature of their reaction with the offending antigen. Numerous antigens have been labeled by chemically combining the isotope with the antigen in a test tube or by introducing into the usual biological synthetic system radioactive compounds utilized in the formation of antigen. These labeled antigens can then be traced by their radioactivity in the blood and tissues and even within the cells. Isotopic tracers can also be used to study the dynamics of the antibody response, antibody synthesis, and rates of antibody breakdown or turnover. Isotopes have made possible more sensitive measures of antigen and antibody so that the physical-chemical reaction between these two materials can be more carefully studied both in the individual and in the test tube. Examples of some of the immunologic advances realized through the use of isotopes are summarized. (C.H.)

27326 [THE PROCESSES INVOLVED IN GENETICS AND OTHER CELL PROCESSES]. Statement of Dr. J. Herbert Taylor (Columbia Univ., New York). p.304-14 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Applications of tritium as a tracer in studies of the incorporation of thymidine into desoxyribonucleic acid are discussed. Radioautography was used to illustrate the results of chromosome labeling, the distribution of tritium to daughter chromosomes during division, and the order of chromosome reproduction in cells. (C.H.)

27327 [USE OF RADIOISOTOPES IN STUDIES ON THE CHEMISTRY OF METABOLISM]. Statement of Dr. A. A. Benson (Pennsylvania State Univ., University Park). p.314-28 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Uses of radioisotopes in studies of the chemistry of metabolism are reviewed. The radiochromatographic method of analysis is described in which paper chromatographic analysis is combined with tracer methods in studies of the dynamics of chemical reactions of the cell. Applications of the method in following the steps in photosynthesis and animal metabolism are described. Applications of activation analysis of biopsy samples in studies of animal metabolism are also described. This method eliminates the handling of radioactive materials. Studies on the identification and properties of surfactant compounds in plant cell membranes and protein-lipid interfaces only a few molecules thick are described which were made possible by the use of tracer methods. (C.H.)

27328 [THE ROLE OF BASIC INSTRUMENTATION IN SCIENTIFIC RESEARCH]. Statement of Dr. C. J. Borkowski (Oak Ridge National Lab., Tenn.). p.329-47 of "Applications of Radioisotopes and Radiation in the Life Sciences."

The field of Bionics is defined as the science of applying knowledge of biology and biological techniques to the design of electronic devices and systems. New developments in instrumentation of importance in studies of the life sciences are reviewed. Instruments discussed include a semiconductor nuclear particle detector, or silicon diode detector, which is closely related to the transistor. The detector is made of highly purified silicon crystals covered by a very thin Au film and is sensitive to various types of radiations such as α, β, γ, and neutrons. The silicon diode detector not only detects nuclear particles but is able to measure their energy with better resolution than other counters. The problem of localizing radioactivity in vivo is discussed, and the design of a highly directional scintillation counter is described. Various procedures for recording and displaying data, including closed circuit television and magnetic tape recording, are discussed. A new technique is described for rescanning films resulting from digital photoscans and increasing the contrast and bringing out additional information on the localization of radioactive materials in brain tumors. Applications of scanning techniques in the early detection of lung cancer following the ingestion and inhalation of radioactive materials and applications of whole-body scanning for various diagnostic purposes are discussed. Other instruments developed recently include those for rapidly and automatically performing basic biochemical separations; instruments for the continuous monitoring of labeled compounds as they are eluted from ion exchange columns; instruments for the complete analysis of living cells and tissues; multichannel pulse-height analyzers for use in conjunction with Coulter counters for sizing and counting particles ranging in diameter from 1000 to 1 μ, such as red blood cells, bacteria, spores, and viruses; tiny, bateryless radio transistors which may be ingested for measuring internal physiological phenomena and the localization of administered radioisotopes; and small personnel radiation monitors which operate continuously for a year on a small battery. The need is stressed for improvements in measuring techniques and instruments. (C.H.)

27329 [RADIATION IN THE SUMMER INSTITUTE PROGRAM]. Statement of Dr. Donald Fluke (Duke Univ., Durham, N. C.) and J. Tyson (Austin High School, Austin, Tex.). p.347-72 of "Applications of Radioisotopes and Radiation in the Life Sciences."

The institute program for training high school and college teachers in radiation biology is supported by the Atomic Energy Commission, the National Science Foundation, and the several universities interested in the program. The scope of the program is reviewed. What the program has meant to high school teachers and pupils is discussed. (C.H.)

27330 [USE OF RADIOISOTOPES AND RADIATION IN TROPICAL AGRICULTURE]. Howard Boroughs (Interamerican Inst. of Agricultural Sciences, Turrialba, Costa Rica). p.395-402 of "Applications of Radioisotopes and Radiation in the Life Sciences."

The present status of research involving radioisotopes and radiation in tropical agriculture is reviewed. It is

pointed out that most of the countries which lie in the tropics are at present trying to reach the economic, industrial, and technical level which will allow them to engage in research using radioisotopes. (C.H.)

27331 [THE DEVELOPMENT OF RADIOISOTOPE SCANNING]. Marshall Brucer (Oak Ridge Inst. of Nuclear Studies, Tenn.), H. O. Anger, P. R. Bell, J. E. Francis, C. C. Harris, A. C. Morris, Jr., Saul Aronow, G. C. Kyker, D. A. Ross, and G. A. Andrews. p.402-26 of "Applications of Radioisotopes and Radiation in the Life Sciences."

The history of the development of radioisotope scanning techniques and equipment is reviewed. Equipment discussed in detail includes the γ-ray scintillation camera which shows the distribution of γ emitting isotopes in small areas of the human body; the ORNL whole-body scanner; directional detectors for scanning, spectrum monitors for γ spectrometry; the design of plastic scintillators for whole-body counting; equipment for positron scanning; the ORINS animal scanner; memory circuits for γ spectrometry; and the interpretation of scintiscans. (C.H.)

27332 USE OF RADIOISOTOPES IN INSECTICIDE STUDIES. John E. Casida (Univ. of Wisconsin, Madison). p.427-38 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Problems and progress in the use of radioisotopes in insecticide research are reviewed. A list is included of labeled insecticides prepared to date; the chemical structure; label; distribution and metabolism in insects, mammals, and plants; chemical studies; plant residues; and insect resistance. The radioisotopes used in labeling insecticides include tritium, C^{14}, P^{32}, S^{35}, Cl^{36}, As^{74}, As^{76}, Br^{82}, I^{131}, and Pb^{212}. (C.H.)

27333 CLINICAL USE OF RADIATION IN ORGAN TRANSPLANTATION. Statement of Dr. Gustave J. Dammin (Harvard Medical School, Boston). p.439-42 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Applications of whole-body irradiation to depress the immune response, and therefore the rejection pattern, in the preparation of animals for various types of grafts are discussed. Examples are cited of the effects of irradiation on response to transplanted kidneys in man and dogs. (C.H.)

27334 ROLE OF A NUCLEAR REACTOR IN MEDICAL RESEARCH AND THERAPY—SHORT-LIVED ISOTOPES, ACTIVATION ANALYSIS, NEUTRON THERAPY, AND NEUTRON CAPTURE THERAPY. Lee E. Farr (Brookhaven National Lab., Upton, N. Y.). p.442-63 of "Applications of Radioisotopes and Radiation in the Life Sciences."

The role of nuclear reactors in medical research and therapy is reviewed. Topics discussed include neutron capture therapy, neutron therapy, activation analysis, and applications of short-lived radioisotopes. Results are summarized from a number of medical studies. (C.H.)

27335 SOME EXAMPLES OF THE USE OF RADIOISOTOPES AND RADIATION IN PHARMACOLOGY. Harold C. Hodge (Univ. of Rochester, N. Y.). p.464-75 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Radioisotopes are well suited to studies of drug absorption, localization, and overall distribution in tissues and organs, and of rates and routes of excretion. Data are tabulated on metabolism of compounds labeled with C^{14}, S^{35}, deuterium, and I^{131}. Studies on antiradiation substances have shown that limited protection can be conferred in animals either by the administration of certain sulfhydryl compounds or by the exclusion of oxygen from radiosensitive tissues. (C.H.)

27336 METABOLISM OF ANIMALS. Max Kleiber (Univ. of Chicago). p.476-96 of "Applications of Radioisotopes and Radiation in the Life Sciences."

The use of P^{32} and C^{45} has greatly improved our knowledge of mineral metabolism. Radioautography of bones after the administration of P^{32} and Ca^{45} has helped to explore bone growth and mobility of bone minerals. Results are reviewed from a number of tracer studies on P and C metabolism and milk formation in dairy cows. (C.H.)

27337 NEUTRON CAPTURE THERAPY AND TREATMENT OF BRAIN TUMORS AND OTHER LESIONS USING RADIOISOTOPES. Statement by Dr. William H. Sweet (Massachusetts General Hospital, Boston). p.496-9 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Procedures and results in the treatment of brain tumors with neutron capture therapy are reviewed. Injected boron compounds, prepared with B^{10}, concentrate in tumor tissue and capture slow neutrons 4000 times as readily as most body substances. The technique to date has been used as an adjunct to surgery. The localization of brain tumors and other lesions of the brain by the differential uptake of radioactive isotopes has become an established diagnostic procedure. This method uses the difference in ability between the tumor and normal brain to remove certain materials from the blood. The most useful isotopes are As^{74}, Cu^{64}, and Ga^{68}. (C.H.)

27338 USE OF RADIATION AND RADIOISOTOPES IN SOIL PHYSICS STUDIES. Statement by C. H. M. van Bavel (Agricultural Research Service, Tempe, Ariz.). p.500-503 of "Applications of Radioisotopes and Radiation in the Life Sciences."

Soil physics is a specialized branch of the exploration of the properties and behavior of soil. It pertains to the mechanical properties of soil, its behavior toward the storage and transmission of water, and the characteristics of the soil gases. Applications of radiation and radioisotopes in soil physics research are reviewed. Topics discussed include measurements of the moisture content of soil in the field and in the laboratory, soil density measurements in the field and in the laboratory, uses of tritium as a tracer for soil water movement, the use of radioisotopes to study growth and activity of roots, and the use of radioisotopes to study irrigation efficiency. (C.H.)

Biochemistry, Nutrition, and Toxicology

27339 (AERE-R-3718) HUMAN BONE METABOLISM DEDUCED FROM STRONTIUM ASSAYS. F. J. Bryant and Loutit (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Apr. 1961. 57p.

An assessment was made of the accuracy and precision of the methods for the determination of Sr^{90}, stable Sr, and Ca in human bone. The results for Sr on samples arising in 1956 to 1959 were reviewed with reference to the variation with time, with domicile, and within the skeleton, and estimates made of the change with age of the discrimination against Ca and of the rates of turnover of bone. (auth)

27340 (HW-69500(p.1-7)) DAMAGE TO RAINBOW TROUT FROM REPETITIVE FEEDING OF Sr^{90}–Y^{90}. R. E. Nakatani and R. F. Foster (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Growth depression and significant mortalities were ob-

served for rainbow trout when they were fed 0.5 μc of $Sr^{90}-Y^{90}$/g of fish daily for 21 weeks, but two other groups of lower treatment levels of 0.05 μc and 0.005 μc $Sr^{90}-Y^{90}$/g of fish did not differ from the control group. A pronounced leukopenia was observed for the high-level treatment group at the end of the test, but leukopenia was not observed for the medium group until six-months post treatment. The body burden of a 300-g trout of the medium-level group was about 310 μc at the end of the test, but no obvious damage was observed. (auth)

27341 (HW-69500(p.8-9)) EFFECT OF CALCIUM ON THE ABSORPTION OF Sr^{85} AND Ca^{45}. R. F. Palmer and R. C. Thompson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Using an in vivo perfusion technique, the absorption of Sr^{85} and Ca^{45} from the small intestine of the rat was shown to be related inversely to the concentration of calcium in the perfusate. The effect on Ca^{45} absorption was greater than the effect on Sr^{90} absorption. (auth)

27342 (HW-69500(p.10-12)) EFFECT OF DIETARY PHOSPHORUS ON STRONTIUM–CALCIUM INTERRELATIONSHIPS IN THE MATURE RAT. R. F. Palmer and R. C. Thompson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Levels of calcium and phosphorus in the diet were shown to influence the relative absorption and retention of Sr^{90} and Ca^{45}. Effects occasioned by changes in calcium intake were usually reduced if corresponding changes were made in phosphorus intake. The effects are too complex, however, to be attributed entirely to a changing Ca/P ratio. (auth)

27343 (HW-69500(p.13-15)) COMPARATIVE TOXICITY OF Sr^{90}, Ra^{226}, AND Pu^{239} IN MINIATURE SWINE. R. O. McClellan and W. J. Clarke, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Male miniature swine of three different ages injected intravenously with Sr^{90}, Ra^{226} or Pu^{239} nine to fifteen months ago have exhibited only minimal pathological damage by the criteria of detection used. (auth)

27344 (HW-69500(p.16-18)) BIOLOGICAL EFFECTS OF Sr^{90} IN MINIATURE SWINE. FIRST PROGRESS REPORT. I. GENERAL CONSIDERATIONS. R. O. McClellan and W. J. Clarke, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Modifications are described in the original experimental design of the Sr^{90} toxicity study in miniature swine. Changes involve the addition of a 125-μc/day group and a reapportionment of numbers of animals so as to concentrate on the offspring of the original experimental animals. About two-thirds of the animals scheduled for daily feeding of Sr^{90} are now on experiment. Progress is reported in the long-term studies initiated in March, 1959, on the biological effects of Sr^{90} in miniature swine. (auth)

27345 (HW-69500(p.19-20)) BIOLOGICAL EFFECTS OF Sr^{90} IN MINIATURE SWINE. FIRST PROGRESS REPORT. II. CLINICAL OBSERVATIONS. R. O. McClellan and W. J. Clarke et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Minor clinical changes observed during the first 18 months of feeding 1, 5, and 25 μc of Sr^{90} per day to miniature swine were limited principally to the first generation offspring at the 25-μc level. These included minor bone changes and a slight depression of growth. (auth)

27346 (HW-69500(p.21-4)) BIOLOGICAL EFFECTS OF Sr^{90} IN MINIATURE SWINE. FIRST PROGRESS REPORT. III. AUTORADIOGRAPHIC STUDIES. N. L. Dockum and R. O. McClellan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Gross autoradiograms of representative bones from pigs on the 25 μc Sr^{90} per day level of feeding are shown. The greatest concentrations of Sr^{90} appeared in dense cortical bone and in the enamel and dentin of teeth. (auth)

27347 (HW-69500(p.25-7)) BIOLOGICAL EFFECTS OF Sr^{90} IN MINIATURE SWINE. FIRST PROGRESS REPORT. IV. UPTAKE IN OFFSPRING. J. R. McKenney and A. C. Case, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Skeletal burdens of Sr^{90} were determined for representative miniature swine in the chronic study during fetal life, at birth, at weaning, and at 6, 9, and 12 months of age. Preliminary estimates of the radiation dose in 6-month-old miniature swine in the 25-μc/day level indicate that the annual dose to bone would approximate 1500 rads. (auth)

27348 (HW-69500(p.31-4)) EFFECTS OF Sr^{89} UPON POPULATIONS OF MEAL MOTHS. H. E. Erdman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Populations of Ephestia, the Mediterranean flour moth, were cultured on cornmeal spiked with different concentrations of Sr^{89}. Several fitness components were measured to illustrate how insect populations react when irradiation is a chronic environmental factor. All levels of Sr^{89} employed in this experiment were detrimental to the developing organisms; those which attained adulthood reproduced another generation even though reduced in numbers. (auth)

27349 (HW-69500(p.35-6)) BIOLOGICAL EFFECTS OF I^{131} IN SHEEP AND SWINE. V. G. Horstman and R. L. Persing, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A reduction of approximately 60 per cent in thyroid uptake of a tracer dose of I^{131} in a group of ewes fed a single 3-mc dose (30,000 rads to thyroid) three and four years ago indicated that the thyroid was severely damaged. Swine fed 5 μc/day for three years (including I^{131} exposure in utero and via the milk during the suckling period from dams on a similar regimen) show no evidence of thyroid damage. Thyroid adenomas were observed for the first time in control animals, one 10 years and one 13 years of age. This probably reflects the naturally occurring incidence in aged sheep on a diet low in stable iodine. (auth)

27350 (HW-69500(p.37-9)) THYROID UPTAKE IN LAMBS OF I^{131} FROM MILK. V. G. Horstman, G. S. Rhyneer, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Thyroid uptake of lambs fed milk to which I^{131} was added was compared with that of lambs given milk from ewes fed I^{131}. Eleven lambs, 1 to 12 weeks old, were given single feedings of milk labeled either in vivo or in vitro with I^{131}, and thyroid uptake was followed by external monitoring. After two weeks the experiment was repeated with the manner of administration reversed so that each lamb received both in vivo and in vitro I^{131}-labeled milk. The per cent uptake of I^{131} appeared to be independent of the manner of radioiodine incorporation. The maximum uptake, expressed as percentage of administered dose per thyroid, was 17 per cent and the effective half-life was seven days. (auth)

27351 (HW-69500(p.40-5)) UPTAKE OF INHALED OR INGESTED RADIOIODINE AND THYROID RADIATION

DOSE. J. R. McKenney (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Equations are given for estimating the thyroid dose following exposure to radioiodine in air, food, or water. The integrated thyroid dose for single or continuous exposures and the maximum thyroid uptake with continuous exposure were estimated for the radioisotopes of iodine in fission products. The values shown are conservative and based upon studies of the uptake of the inhaled and ingested radioiodine in Suffolk sheep. (auth)

27352 (HW-69500(p.46-50)) METABOLISM OF Zn^{65} IN PREGNANT EWES. J. R. McKenney and R. O. McClellan, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Three ewes in advanced pregnancy were administered radiozinc daily for two weeks. Highest concentrations of Zn^{65} were observed in liver, kidney cortex, mammary tissue, pancreas, and spleen, respectively. The fetuses contained concentrations one-tenth to one-half those in comparable tissues of the ewes. At least three days elapsed before appreciable uptake was observed in the blood cells of the ewes. Colostrum contained a Zn^{65} concentration 20 to 30 times plasma compared to a value of about 10 times plasma in the milk at three days after parturition. (auth)

27353 (HW-69500(p.51-4)) INTERNAL DOSIMETRY OF Zn^{65} IN SHEEP. J. R. McKenney and R. O. McClellan, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Direct radiation dose measurements were taken in sheep previously fed Zn^{65} daily for a period of two weeks. The largest fraction of the radiation dose to the gonads and developing fetuses was observed to be the result of external gamma radiation from Zn^{65} in the gastrointestinal tract and other tissues of the body. "Total body" as an organ of reference was observed to be a good estimator as the critical organ for the more radiosensitive tissues in the animals used. (auth)

27354 (HW-69500(p.55-9)) METABOLISM AND DOSIMETRY OF Cs^{137} IN RAMS. R. O. McClellan, J. R. McKenney, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Between 50 and 80 per cent of ingested Cs^{137} was absorbed from the gastrointestinal tract of rams. Fecal and urinary excretion following a single oral dose were approximately equal over a 20-day period. On the basis of radiation dose measurements, gonads and whole body were equally important as the critical organ in animals receiving Cs^{137} daily. (auth)

27355 (HW-69500(p.60)) PRELIMINARY OBSERVATIONS ON $Ce^{144}-Pr^{144}$ IN SHEEP. J. R. McKenney, R. O. McClellan, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The use of cerium as a possible heat source for lightweight electrical power units has stimulated interest in its metabolism. Preliminary to a limited study of this radionuclide in sheep, one ram was given a single intravenous injection of 2 mc of $Ce^{144}-Pr^{144}$ and sacrificed two weeks later. Tissues were analyzed for radiocerium. Results of the measurements are tabulated. (auth)

27356 (HW-69500(p.61-3)) METABOLISM OF Np^{237} IN THE RAT. J. E. Ballou (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Investigation of the metabolism of Np^{237} indicates gastrointestinal absorption may be higher than that listed by the ICRP. The preliminary nature of this study permits only recommendations for further investigation. (auth)

27357 (HW-69500(p.64-6)) EFFECTS OF INTRADERMAL INJECTION OF PLUTONIUM IN SWINE. V. G. Horstman, R. L. Persing, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A 40 to 60% retention was observed one to two months after intradermal administration to swine of plutonium(IV) nitrate at levels of 0.04 to 5 μc/site. Scabs which formed at these sites contained over 80% of the retained dose. Injected areas showed a discoloration that still remained after six months. Swelling was noted in some of the highest level sites five months following injections. (auth)

27358 (HW-69500(p.67-76)) PLUTONIUM INHALATION STUDIES. W. J. Bair, D. H. Willard, and J. E. West (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Immediately following a single exposure of beagle dogs to $Pu^{239}O_2$, 40 to 85% of the total Pu^{239} deposited was recovered from lungs. Deposition and retention of Pu in lungs was less for particles with a geometric mean diameter by weight of 1.7 μ than for 4.3-μ particles, but a larger percentage was excreted in the urine. Retention was also less when the amount deposited was increased. For 4.3-μ particles the half-time for pulmonary retention was about 2,000 days. There was marked accumulation of Pu in bronchial lymph nodes but only trace amounts were translocated to other tissues. In other dogs death occurred at times up to more than one year following deposition of more than 0.1 μc/g of lung. Histopathologic effects were confined to lungs and bronchial lymph nodes. (auth)

27359 (HW-69500(p.77-80)) TRANSLOCATION AND INHALATION OF $Ce^{144}O_2$. R. A. Hennacy (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Data from one exposure of 24 rats to $Ce^{144}O_2$ aerosol are described. After the original clearance of the upper respiratory passages, the lung burden remained essentially constant. Elimination of cerium was thereafter very slow, with at least 98% of the clearance via the gastrointestinal tract. (auth)

27360 (HW-69500(p.81-6)) PRELIMINARY STUDIES ON THE ELIMINATION OF STRONTIUM BY TROUT. R. H. Schiffman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A method to evaluate the pathways of Sr excretion from rainbow trout was developed. Results of two experiments indicate that 6 to 7% of the injected dose is in the urine, 3 to 4% in the gut, and 50 to 75% remains in the fish after 22 hr. This would infer that 15 to 40% of the injected dose is transported out of fish via the gills and/or the skin. (auth)

27361 (HW-69500(p.92-6)) EFFECT OF SOIL MOISTURE ON UPTAKE AND TRANSLOCATION OF CESIUM-137 AND POTASSIUM IN BEAN PLANTS. J. D. Stewart (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Increasing soil moisture tension increased plant uptake of Cs^{137} to a greater extent than K. Ratio of Cs^{137} to K showed values as high as four for some plant tissue. The addition of carrier Cs and NPK to the soil did not significantly alter the effect of soil moisture tension on Cs^{137} and K uptake. (auth)

27362 (HW-69500(p.97-102)) CALCIUM AND WATER UPTAKE BY BARLEY PLANTS. D. A. Barber and H. V. Koontz (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

No direct relationship has been found between Ca uptake to the shoots and concurrent transpiration in barley seedlings. Both processes were inhibited by 2-4 dinitrophenol (DNP), Ca uptake showing a greater sensitivity. The action of DNP was found to be markedly pH dependent. (auth)

27363 (HW-69500(p.103-7)) MECHANISM OF CALCIUM–STRONTIUM DISCRIMINATION IN PLANTS. R. L. Uhler, O. Biddulph, and F. P. Hungate (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Bean plants were grown in nutrient solution to which Ca^{45} and Sr^{85} were added. Relative concentrations of these isotopes in different plant parts were observed to change with time. The more rapid initial movement of Sr^{85}, compared to Ca^{45}, to leaves was assumed to be due to Ca^{45} exchange with stable calcium pre-existing in stems and roots. (auth)

27364 (HW-69500(p.111-13)) WOUND DECONTAMINATION WITH EDTA. J. E. Ballou (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Results of limited studies with rats suggest that chelating agents such as EDTA, when applied to Pu contaminated wounds, offer little advantage in removal of the Pu and may significantly increase its absorption into the body. (auth)

27365 (HW-69500(p.138-41)) Sr^{90} AND Ca^{45} BINDING IN BLOOD. J. R. McKenney, W. E. Ham, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The ultrafiltrability of Ca^{40} and added Ca^{45} and Sr^{90} was measured both in plasma of sheep after in vitro addition of varying levels of Ca^{40} and in serum of ewes following the feeding of varying levels of calcium gluconate. There was no appreciable difference in the ultrafiltrability of Ca^{45} and Sr^{90}. Serum calcium in excess of 7 mg/100 ml appeared to be bound and not traceable with in vitro-added Ca^{45}. (auth)

27366 (HW-69500(p.173-9)) RADIONUCLIDES IN HANFORD WILDLIFE–1960. W. C. Hanson and D. G. Watson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Concentrations of radioisotopes in tissues of biological indicator organisms and game species of the Hanford Reservation were generally greater than during 1959. Important increases occurred in fish and waterfowl from the Columbia River. (auth)

27367 (HW-69500(p.180-3)) RADIOACTIVITY IN BURNED VS. UNBURNED GRASS FIELDS. J. J. Davis, W. C. Hanson, and D. G. Watson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The amounts of gamma emitters from fall-out are compared between grass harvested from an area burned during the previous year and an adjacent unburned area. The burned area produced a larger crop of grass but lower levels of radionuclides on both weight and unit area basis. (auth)

27368 (TID-3562) COBALT IN BIOLOGICAL METABOLISM. A Literature Search. Charlie M. Pierce, comp. (Office of Technical Information Extension, AEC). Apr. 1961. 124p.

References (972) are given to Chemical Abstracts published during the period January, 1955 through July, 1960. For convenience in abstract scanning the abstract numbers are given. An author index is also included. (P.C.H.)

27369 (TID-13100) STUDIES OF NUCLEIC ACID AND PROTEIN SYNTHESIS IN ESCHERICHIA COLI. Progress Report. Charles Hurwitz and Richard A. Peabody (Albany Medical Coll., N. Y.). June 28, 1961. Contract AT(30-1)-2461. 5p.

Studies, using tracer techniques, were carried out to clarify previous results with E. coli K-12 showing that protein synthesis can occur at very low levels of nucleic acid synthesis. The status of the mandatory coupling hypothesis, evaluating protein and nucleic acid synthesis in terms of requirements for net formation vs turnover and the nature of the control exerted by ribose and ribose precursors, is discussed. When nucleic acid synthesis was reduced by 95% or more by omission of ribose precursors from the medium, no net synthesis of protein could be detected by the Folin-Cicolteau technique. An investigation of deficiencies in the system that would prevent net synthesis from occurring was carried out. Studies with labeled compounds indicated that protein synthesis, resulting from turnover of existing protein, can occur when nucleic acid synthesis is at least 95% inhibited, but that net protein synthesis may not occur in the absence of net nucleic acid synthesis. (M.C.G.)

27370 (UR-593) THE EFFECT OF INHALED RADON ON THE SURVIVAL, BODY WEIGHT AND HEMOGRAM OF THE MOUSE FOLLOWING SINGLE EXPOSURES. D. A. Morken (Rochester, N. Y. Univ. Atomic Energy Project). Apr. 26, 1961. Contract W-7401-eng-49. 50p.

Mice exposed to single exposures of Rn by inhalation, with daughter products absent, exhibited a shortened lifespan, a reduced body weight, and a prolonged depression of the red blood cell concentration. The effect on mortality and body weight appeared to be proportional to the dose, whereas the effect on the red cell concentration was not. Rn was less effective than Po in reducing lifespan. Dose calculations for this experiment show that the radiologic dose from Rn is delivered essentially from alpha particles within the period of exposure. (auth)

27371 (UR-599) THE INFLUENCE OF ADRENALECTOMY ON THE METABOLIC ACTIONS OF GLUCAGON IN THE FASTED RAT. Stanley R. Glasser, Joseph L. Izzo, and S. Lee Crump (Rochester, N. Y. Univ. Atomic Energy Project). Dec. 30, 1959. Contract W-7401-eng-49. 24p.

The metabolic effects of daily injections of glucagon during a five-day fast were investigated in adrenalectomized female rats maintained on either saline or hydrocortisone. As in the intact fasting rat, administration of glucagon to the adrenalectomized animal maintained on saline caused an increased urinary excretion of nitrogen, phosphorus and creatinine; a greater loss in body weight and decreased mass of liver and muscle tissues; and a fall in blood α-amino nitrogen. However, these changes were lesser in magnitude than the changes observed in the intact fasted rat. In contrast to its effects in the intact rat, administration of glucagon to the adrenalectomized animal maintained on saline did not depress liver glycogen but did elevate blood sugar and muscle glycogen. The metabolic responses to glucagon by adrenalectomized rats maintained on hydrocortisone were similar to those noted in the intact fasted animal. These studies suggest that the protein catabolic action of glucagon is not dependent on the presence of the adrenal cortex. They further suggest that the effects of glucagon on protein metabolism are an integral part of this hormone's action. (auth)

27372 (CEA-tr-R-1364) PARTICULARITÉS DE LA RÉPARTITION ET DE L'EXCRÉTION DU POLONIUM CHEZ LES ANIMAUX A QUI ON ADMINISTRE DE L'UNITIOL. (Particulars of the Distribution and Excretion of Polonium in the Case of Animals That Have Been Administered Uni-

tiol). E. V. Erleksova. Translated into French from Med. Radiol., 4: No. 8, 54-60(1959). 14p.

The immediate application of unitiol (from 100 to 50 mg/kg) after the introduction of polonium (0.1 mc/kg) in the organism accelerates and augments, quantitatively, the elimination of this element from the organism. Polonium is chiefly eliminated by the urinary system where it is most concentrated. As a result, the polonium concentration decreases in the other hematopoietic organs. The life span of white rats receiving unitiol is increased from 13 to 95 days. The acute development of the sickness takes a chronic form. The morphological manifestations of the action of polonium in the course of the use of unitiol in the hematopoietic organs are delayed and do not take so painful a form as that occurring in animals dying on the 11th to 13th and 20th day after intradermal injection of polonium. The macrophage reaction is decreased in the experimental animals, and from this fact the quantity of zones creating an ionization power connected to the capture of polonium by the macrophages is decreased. Because of the large accumulation of polonium in the kidneys, distrophic variations are developed much earlier in the experimental animals than in the samples and exhibit a painful character (image of a non-cellular nephroscherosis between the 102nd and the 115th day). (tr-auth)

27373 (JPRS-9726) MIGRATION OF Sr^{90} ALONG THE BIOLOGICAL CHAIN: PLANT—SHEEP—FETUS. L. A. Buldakov and Yu. I. Moskalev. Translated from Byull. Eksptl.' Biol. Med., 50: No. 10, 111-13(Oct. 1960). 5p.

Results are presented of a study of Sr^{90} migration along the biological chain: plant—sheep—fetus of sheep. Tests were carried out on 12 adult pregnant sheep. The sheep were fed hay containing Sr^{90} for a period of 6 months and then killed. The content of Sr^{90} and stable calcium in the skeleton was determined in them as well as in their fetuses. Results showed that the relative Sr^{90} concentration in the skeleton of the mother was 2.3 times as high as the activity in the fetus. As Sr^{90} migrated along the biological line the concentration of activity decreased. (M.C.G.)

27374 SEASONAL VARIATIONS IN ENDOCRINE RESPONSE TO CRYPTORCHIDISM. Samuel A. Gunn, Thelma Clark Gould, and W. A. D. Anderson (Univ. of Miami, Coral Gables, Fla.). Acta Endocrinol., 37: 589-96(Aug. 1961).

Seasonal variations in the capacity of the rat dorsolateral prostate to take up Zn^{65} were demonstrated. 60 to 85% higher Zn^{65} uptake values were noted at certain times of year (high phase) than at other times of year (low phase). The studies suggested using the Zn^{65} uptake technique to determine if there were any subtle alterations in male hormone level following surgically induced cryptorchidism in rats. When the Zn^{65} uptake by the dorsolateral prostate of control animals was in a high phase, there was a transient lowering of Zn^{65} approximately one week following cryptorchid surgery. In contrast, at times of year when the capacity of the dorsolateral prostate to take up Zn^{65} was already in a physiological low, there was no further depression of glandular activity caused by the cryptorchid state. The importance of hidden seasonal rhythms in endocrine experimentation, even in the laboratory rat housed under constant environmental conditions, is emphasized. (auth)

27375 STUDIES OF STABLE IODINE METABOLISM AS A GUIDE TO THE INTERPRETATION OF RADIOIODINE TESTS. D. A. Koutras, W. D. Alexander, W. W. Buchanan, J. Crooks, and E. J. Wayne (Western Infirmary, Glasgow). Acta Endocrinol., 37: 597-606(Aug. 1961).

The significance of the size of the iodine pools in which the radioiodine is diluted in the thyroid is analyzed, and it is shown that there is a danger in interpreting radioiodine tests in isolation. The uptake of I^{131} is inversely related to the extrathyroidal inorganic iodine pool, and the PBI^{131} is inversely related to the intrathyroidal iodine pool. Both these pools may be diminished in euthyroid persons and thus a high uptake of I^{131} may be associated with a high PBI^{131} and so lead to false diagnostic conclusions. In order to avoid diagnostic errors, standard I^{131} tests should never be reported without some knowledge of relevant clinical features, for example, whether there is the possibility of prolonged iodine deficiency, of previous treatment, of Hashimoto's disease, or of dyshormonogenesis. In this way due weight can be given to factors which increase or decrease the iodine pools of the body and discrepancies between the clinical picture and radioiodine tests become obvious. More specific investigations can then be undertaken in appropriate cases. (auth)

27376 SERUM AND TISSUE RESIDUES FOLLOWING SELENIUM INJECTIONS IN SHEEP. Kenneth L. Kuttler, Donald W. Marble, and Clifton Blincoe (Univ. of Nevada, Reno). Am. J. Vet. Research, 22: 422-8(May 1961).

Observations were made on serum selenium levels and tissue residues following the subcutaneous injection of radioactive sodium selenite at the rate of 5 mg per 100 lb of body weight and radioactive barium selenate at the rate of 20 and 50 mg per 100 lb of body weight. Injections were made in the shoulder and in the ear. The sodium salt was found to be absorbed and eliminated more rapidly than the barium selenate. Measurable selenium tissue residues, recorded 148 days after injections, corresponded with serum levels. The highest selenium residues were found in kidneys, with relatively decreasing amounts seen in spleen, lungs, brain, heart, and wool. Fat and bone had the lowest accumulations of selenium. With barium selenate, the site of injection influenced serum and tissue levels. Injections in the ear were absorbed less efficiently than injections in the shoulder. Toxicity experiments were conducted with barium selenate and sodium selenite. Sodium selenite was found to be lethal at 80 mg per 100 lb of body weight, and it was found to produce toxic reactions at 40 mg per 100 lb of body weight. Barium selenate, at the rate of 1,080 mg per 100 lb of body weight, was nontoxic other than causing a local reaction at the site of injection. (auth)

27377 SELF-ABSORPTION CORRECTION IN THE USE OF TRITIUM-LABELED SUBSTRATES FOR ENZYME ASSAYS. Richard E. Beltz (Coll. of Medical Evangelists, Loma Linda, Calif.). Anal. Biochem., 2: 303-16(1961). (In English)

Solid tritium-tagged samples of finite thickness were assayed in the Geiger region in a windowless flow counter and corrected for self-absorption by comparison with the counting rates of duplicate samples to which internal standards of tritium were added. For the determination of absolute activities, measurements of sample weights are not required. Uniform or reproducible distribution of material on replicate plates was attained through an improved plating technique. The use of this method is demonstrated in assays of thymidine kinase and deoxycytidylic acid deaminase employing thymidine-H^3 and deoxyctidylic acid-H^3 as substrates. (auth)

27378 BONE MARROW CHANGES IN CHRONIC CADMIUM POISONING IN RABBITS. Maths Berlin, B. Fredricsson, and G. Linge. Arch. Environmental Health, 3: No. 2, 176-84(Aug. 1961).

Cadmium poisoning produces microcytic hypochromic anemia in rabbits. Parenteral administration of iron is followed by regression of this anemia. Femoral bone marrow was studied quantitatively in cadmium-poisoned and control rabbits with and without iron therapy. Data are tabulated. (C.H.)

27379 TOXICOLOGY OF SELENIUM AND TELLURIUM AND THEIR COMPOUNDS. Edward A. Cerwenka, Jr., and W. Charles Cooper. Arch. Environmental Health, 3: No. 2, 189-200(Aug. 1961).

A comprehensive survey of the toxicological properties of selenium and tellurium and their compounds is presented. Although selenium has been used commercially for many years with no long-term systemic effects on industrial workers, selenium has long been regarded as a toxic substance. This belief stems principally from the well-known selenium poisoning of cattle caused by the consumption of seleniferous plants. Although elemental selenium is relatively nontoxic, certain selenium compounds are definitely toxic toward humans, the most seriously toxic being hydrogen selenide. Recent studies have indicated that selenium has an important role in animal nutrition and may be of particular value in the treatment of a number of deficiency diseases. Therefore it is important that reliable data be available on the toxic level of various selenium compounds toward different animal species. Considerably less is known about the toxicity of tellurium and its compounds than about the toxicity of selenium. In general it appears that tellurium is less toxic than selenium, although there are exceptions to this rule. The recent developments on semiconducting tellurium compounds for thermoelectric applications have greatly increased the interest in the toxicity of tellurium and its compounds. A critical survey of the available data is presented in this review. (67 references). (auth)

27380 EFFECT OF CORONARY BLOOD FLOW ON RADIOISOTOPE DILUTION CURVES MEASURED BY PRECARDIAL SCINTILLATION DETECTION. Ismael Mena, Albert A. Kattus, Moses A. Greenfield, and Leslie R. Bennett (Univ. of California, Los Angeles). Circulation Research, 9: 911-18(July 1961).

Two series of animal experiments are reported. In the first, the disappearance rates of intravenously injected radioactive boluses were monitored over the heart and from a peripheral artery. The disappearance rate over the heart was shown to be slower than in the artery. In a second series of experiments in which injection was made into the left ventricle or into a coronary artery while sampling from the right side of the heart, it was shown that the coronary transit time was several times longer than the left ventricular transit time. The prolonged presence of the radioactivity in the coronary vascular bed accounts for the difference in the heart and arterial disappearance slopes. A ratio of these two slopes may provide an index of coronary blood flow. (auth)

27381 TRANSPORT OF K^{42+}, Na^{24+}, AND I^{131-} BY THE PULMONARY CIRCULATION. CALCULATIONS OF CARDIAC OUTPUT AND VOLUME FROM DILUTION CURVES OBTAINED IN THE CANINE HEART-LUNG PREPARATION. David Yudilevich (Univ. of Tennessee, Memphis). Circulation Research, 9: 925-35(July 1961).

The transport of K^{42+}, Na^{24+}, and I^{131-} by blood through the heart and lungs in the canine heart-lung preparation was studied. Simultaneous injection of each tracer was performed together with nondiffusible Risa as a reference label. The data show that in a single passage through the lung, a fraction of the injected radioactive electrolyte moves out from the blood and partially returns. This alters the shapes of the dilution curves and the results of cardiac output and central volume calculations. The implications of these findings in the suggested use of radioactive electrolytes for the application of the Stewart-Hamilton method in human and animal investigations is discussed. The possibility is suggested that in the Starling preparation, the difference in flows calculated from the extrapolated and complete dilution curves of a non-diffusible tracer may be related to the coronary flow. (auth)

27382 DEUTERIUM FRACTIONATION DURING MOLECULAR HYDROGEN FORMATION IN A MARINE PSEUDOMONAD. Micah I. Krichevsky (National Inst. of Allergy and Infectious Diseases, Bethesda, Md.), Irving Friedman, Marcia F. Newell, and Frederick D. Sisler. J. Biol. Chem., 236: 2520-5(Sept. 1961).

Formic hydrogenlyase, but not formic dehydrogenase or hydrogenase (hydrogen utilization), was partially inhibited by 33% D_2O or completely deuterated sodium formate. Thus hypothesis that one, but not two, of the atoms in the evolved hydrogen was in immediate equilibrium with the medium is supported. Mass spectrometric analyses of the hydrogen produced by growing cells showed a deuterium content of about 30 ppm (depleted by a factor of 4.4 to 5.1; theoretical factor = 3.87). The same was true whether glucose or formate was the substrate. The intracellular water and cellular hydrogen were not significantly depleted in deuterium. It is concluded that the fractionation takes place during formate utilization. (auth)

27383 STUDIES IN THE METABOLISM OF CARRIER-FREE RADIORUTHENIUM. II. THE UPTAKE OF NITROSYLRUTHENIUM COMPLEXES FROM THE GASTROINTESTINAL TRACT. R. S. Bruce and T. E. F. Carr (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 14: 145-54(July 1961).

Carrier-free radioruthenium, as the nitrosyl-trinitrate, has been administered orally to rabbits and rats, both as a single dose and as repeated doses for a prolonged period. The amount of ruthenium absorbed and the distribution within the tissues have been estimated. Rabbits absorbed 13 per cent of a single dose and rats absorbed about 3 per cent, while after 7 days the amounts retained in the tissues were 1 per cent and 0.4 per cent, respectively. The half-time for elimination of ruthenium by the rabbit during the first 10 days was 1.6 days and thereafter increased to at least 7 weeks. After 50 weeks, during which ruthenium was administered twice weekly to a rabbit, only 3.8 per cent of the average weekly dose was retained in the animal 18 days after the last dose. It is concluded that the retention from each of the serial doses was less than that from a single dose. The amount of ruthenium retained by rats receiving ruthenium twice weekly, did not increase between 41 and 58 weeks and averaged 3 per cent of the weekly dose. No single tissue exhibited a particularly high concentration of ruthenium after either single or multiple doses. It would appear that some part of the nitrosyl-ruthenium combines with the tissues and that the rate of loss of ruthenium from a tissue may be governed by its catabolic rate. (auth)

27384 METABOLIC STABILITY OF BODY CONSTITUENTS. A. N. Davison (Guy's Hospital Medical School, London) and J. Dobbing. Nature, 191: 844-8(Aug. 26, 1961).

An appraisal is given of some modern views on the collective metabolism of body constituents in vivo. A working hypothesis, embracing the metabolism of body constituents

as a whole, and its influence on both the design and interpretation of metabolic experiments in vivo, is included. (P.C.H.)

27385 CALCIUM METABOLISM IN MAN WITH CALCIUM-45: MALABSORPTION SYNDROME AND EXUDATIVE ENTEROPATHY. G. Milhaud and P. Vesin (Institut Pasteur, Paris and Hôpital Saint Antoine, Paris). Nature, 191: 872-4(Aug. 26, 1961).

Case studies are presented of four patients with either the malabsorption syndrome or exudative enteropathy. In all, radiological examination of the small intestine was typical: dilatation or hypertony of loops and dilution or scattering of barium. Examination of calcium metabolism was carried out with calcium-45. Steatorrhea was demonstrated by the triolein-I^{131} test, and protein loss into the intestine was determined indirectly by means of the PVP-I^{131} test. (P.C.H.)

27386 STUDIES ON THE UPTAKE OF Au^{198}. N. Mori (Nihon Univ., Tokyo). Nichidai Igaku Zasshi, 18: 2699-2705 (1959).

Twenty mc of Au^{198} in a physiologic NaCl solution of 20 ml was injected intravenously in rabbits, rats, and mice. In rabbits the uptake of Au^{198} was exponential and reached a maximum within 10 min. In mice Au^{198} was most markedly taken up by the liver, followed by the spleen. This was also true in rats. The greatest uptake occurred during the 24 hr after injection. The marked accumulation of Au^{198} in the liver and spleen was confirmed by autoradiography of rat tissue slices. (Abstr. Japan Med., 1: No. 10, 1961)

27387 EFFECT OF X-RAY RADIATION ON GLUTATHIONE METABOLISM. Y. Kitamura (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2606-38(1960).

Glutathione in the liver, muscles, and blood of rabbits showed a noticeable decrease. A marked decrease of the liver glutathione was seen when a single dose of 4000 r was applied to the liver or 1000 r to the whole body. The same effect was seen in 6000 r of fractioned irradiation to the liver, or 2000 r of fractioned whole-body irradiation. No definite change in muscular glutathione was found after a single dose of 4000 r to the liver, but a moderate decrease of glutathione was observed after a single dose of 1000 r whole-body, 6000 r of fractioned irradiation to the liver, and 2000 r of fractioned whole-body irradiation. The blood glutathione decreased markedly after a single dose of 4000 r to the liver or a single dose of 6000 r whole-body, and fractionated irradiation totaling 6000 r to the liver and 1000 r whole-body. As counter-measures against injury to the glutathione metabolism system from the x irradiation to the liver, the prescription of L-methionine or glucuronic acid was shown to be the most effective with vit. B_{12} next, while no effect of glucose and vit. B_1 was confirmed. The blood glutathione of patients who were treated with a series of deep therapy was found to have diminished noticeably after x irradiation of 7000 r to 12000 r. (Abstr. Japan Med., 1: No. 10, 1961)

27388 THE GENERAL PHARMACOLOGY OF THE HEAVY METALS. H. Passow, A. Rothstein, and T. W. Clarkson (Physiologisches Universitätsinstitut, Hamburg and Univ. of Rochester, N. Y.). Pharmacol. Revs., 13: 185-224(June 1961).

A discussion of predominantly theoretical aspects of metal poisoning is presented. Heavy metals are capable of combining with a wide variety of organic molecules. The heavy metal binding was found to occur simultaneously at sensitive and insensitive sites. This diversion of the metals to insensitive sites protects the cell to some extent against the toxic action of metals, but at the same time tends to obscure the relation between metal binding and pharmacological response. The interactions of heavy metals with simple molecules, proteins, enzymes, cells, organs, and animals are reviewed. The responses of biological systems to heavy metals were considered in terms of inferences that could be made concerning the site of the original chemical insult. A listing and discussion of the most commonly seen responses are given. (M.C.G.)

27389 A RELATIONSHIP BETWEEN BORON AND AUXIN IN C^{14} TRANSLOCATION IN BEAN PLANTS. James J. Dyar and Kenneth L. Webb (Ohio State Univ., Columbus). Plant Physiol., 36: 672-6(Sept. 1961).

Bean plants, Phaseolus vulgaris L. var. Black Valentine, were used in experiments designed to test the hypothesis that the role of boron in translocation is indirect, the boron exerting its influence on this process through effect on metabolic activity at sites of utilization. Naphthaleneacetic acid applications to the meristems of boron-deficient plants in the absence of added boron, promoted increased translocation of photosynthetically incorporated C^{14}. It was therefore concluded that the boron deficient plant, prior to phloem necrosis, possesses a translocation system capable of functioning and that it functions at a much reduced capacity because substrates are not being utilized. It is consequently quite clear that boron deficient plants are not limited in growth by sugar deficiency and that boron is not necessary to sugar translocation per se. The relationship between boron and auxin was considered and the suggestion revived that boron is essential to auxin metabolism, possibly synthesis. (auth)

27390 MATHEMATICAL MODELS OF RADIONUCLIDES IN MILK. E. K. Harris, D. S. Licking, and J. B. Crounse (Robert A. Taft Sanitary Engineering Center, Cincinnati). Public Health Repts. (U.S.), 76: 681-90(Aug. 1961).

Mathematical models were developed and fitted to monthly observations of strontium-89, barium-140, and iodine-131 in milk samples from five milksheds serving large urban populations. The most complicated of the models included the following factors: previous nuclear weapons tests, radioactive decay, monthly precipitation, and the proportion of cows on pasture each month. This model fitted reasonably well all series of data except those for barium-140 and iodine-131 in one of the milksheds, and strontium-89 in 3 of the milksheds. Simpler models included only the last two of the four factors expressed separately or as a product. These models were far too rigid to describe the sudden peaks and dips in barium-140 and iodine-131 data. They did better with strontium-89 but not as well as the first model. Further work with one of the models, modified by the addition of a simple time-trend, should test its applicability to the series of long-lived nuclide concentration. (P.C.H.)

27391 STUDY UPON THE TRITIATED THYMIDINE INCORPORATION INTO DEOXYRIBONUCLEIC ACID OF TISSUE CULTURED HeLa CELLS. Toyozo Sekiguchi (National Inst. of Radiological Science, Chiba, Japan), Takako Kankura, Hideo Eto, and Tetuo Iwakura. Radioisotopes (Tokyo), 10: 135-9(Apr. 1961). (In Japanese)

HeLa cells (1×10^7) were cultured by the tissue culture method with 10 ml of a medium consisting of 8 parts Earles' saline solution and 2 parts bovine serum. The cells were incubated with 0.5 μc/ml final concentration of H^3-thymidine and, in a second experiment, with 1.0 μc/ml final concentration of P^{32}. At 1, 3, 6, and 24 hours after incubation, the

radioactivity incorporated into deoxyribonucleic acid (DNA) was measured. The DNA was extracted as sodium nucleate with 10% sodium chloride solution and purified with alcohol and ether. The tritium was measured by two methods, by a gas flow counter and a liquid scintillation spectrometer. The value obtained by the latter method was lower than the former (~39%). Thymidine was rapidly incorporated into DNA at 1 hour incubation but phosphorus was not incorporated at 1 hour and only slightly at 3 hours. The specific activity of DNA incubated with thymidine was 3 or 4 times higher than that of phosphorus. (auth)

27392 THE FATE OF H^3-THYMIDINE LABELED CELLS INJECTED AS A POTENTIAL HUMAN MARROW GRAFT. Teruo Nagai (National Inst. of Radiological Science, [Chiba, Japan]) and Ralph H. Kniseley. Radioisotopes (Tokyo), 10: 154-62(Apr. 1961). (In English and Japanese)

Bone marrow was labeled in vitro with H^3-thymidine to trace the cells after injection in two patients. In one patient with disseminated malignant neoplasm, autologous labeled marrow (5.1×10^9 nucleated cells containing 2.1×10^8 labeled immature cells) was infused intravenously after 360 r of whole-body gamma irradiation. A second patient with aplastic anemia was given, without irradiation, homologous labeled marrow (2.1×10^9 nucleated cells containing 2.3×10^8 labeled immature cells) from a normal donor who had the same ABO and Rh compatible blood groups. In the first patient peripheral blood and bone marrows were taken at 10 minutes postmarrow infusion, every day for 4 days, and after that at intervals of a few days. Autoradiograms of 4 ~ 10 films of each sample of bone marrow and of the buffy coat of peripheral blood were prepared and scanned. The result indicated that the injected marrow survived for a time. It was shown that injected cells were capable both of mitosis and maturation. Labeled autologous and homologous marrow cells can be detected in the recipient for at least 10 days. (auth)

Fallout and Ecology

27393 DIETARY COMPONENTS AND ACCUMULATION OF RADIONUCLIDES IN THE BODY. Nutrition Revs., 19: 245-7(Aug. 1961).

In the U. S. about 39% of the Sr^{90} and Cs^{136} in the diet comes from dairy products, and the remainder from other foods. In the absence of weapons testing, the proportion of radionuclides from milk will decrease and from nonmilk products will increase. (auth)

27394 RADIONUCLIDES, CALCIUM, AND POTASSIUM IN MILK. Nutrition Revs., 19: 253-4(Aug. 1961).

A wide variation is found in the level of radionuclides and of calcium and potassium found in milk. Superimposed on the levels found is a marked seasonal variation. (auth)

Radiation Effects on Living Tissues

27395 (HW-69500(p.87-91)) RADIATION EFFECTS ON MEMBRANE PERMEABILITY IN YEAST. R. T. O'Brien (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Data are presented which indicate that radiation increases the frequency of sites through which materials diffuse out of yeast cells. Sulfhydryl groups in the membrane were shown to be radiation sensitive. (auth)

27396 (HW-69500(p.131-3)) DELAYED EFFECTS OF Y^{90} INGESTION. M. F. Sullivan, S. Marks, and R. C. Thompson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The gastrointestinal tracts of rats were chronically irradiated by addition of Y^{90} to their drinking water. Animals surviving an average intake of 410 μc/day for 60 days exhibited a median post-treatment survival of 300 days, as compared to approximately 400 days for animals consuming an average 91 μc/day and 570 days for controls. Notable is the paucity so far of tumors originating in the GI tract. (auth)

27397 (HW-69500(p.134-7)) EFFECTS OF COMBINED PLUTONIUM AND X IRRADIATION IN THE RAT. J. E. Ballou (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Rats administered 32 μc Pu/kg and 400 r total-body x ray were not protected by delaying the x-ray exposure 14 or 28 days. Pu administered with diethylenetriaminepentaacetate (DTPA) was less toxic in combination with x irradiation than equivalent Pu citrate solutions. Approximately 90% of the Pu administered with a 12 times molar excess of DTPA was excreted in two days. (auth)

27398 (HW-69500(p.142-3)) ACUTE EFFECTS OF HIGH LEVELS OF Sr^{90} IN THE BLOOD OF MINIATURE SWINE. P. L. Hackett and W. J. Clarke, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Intravenous injection of 270 μc of Sr^{90} per kg body weight in each of three adult miniature swine resulted in a depression in neutrophil, lymphocyte, and platelet counts. (auth)

27399 (NAS-NRC/Pub-848) EFFECTS OF INHALED RADIOACTIVE PARTICLES. (National Research Council). 1961. 78p. (A/AC.82/G/L.567)

Available information is reviewed on the potential hazards of inhaling radioactive particles. Included are discussions on the properties and sources of radioactive particles, the relevent physiology of the respiratory tract, the probable mechanisms of particle deposition in the respiratory tract and their removal from the tract, pathologic effects from external sources and of deposited material, and the application of these factors to assess the possible damage due to inhaling radioactive particles. 179 references. (C.H.)

27400 (NAS-NRC/Pub-849) REPORT OF THE SUBCOMMITTEE ON LONG-TERM EFFECTS OF IONIZING RADIATIONS FROM EXTERNAL SOURCES, OF THE COMMITTEE ON PATHOLOGIC EFFECTS OF ATOMIC RADIATION. (National Research Council). 1961. 82p. (A/AC.82/G/L.568)

Data are reviewed on the permanent and delayed somatic effects of ionizing radiations from external sources. Emphasis is placed on radiation effects in the human. Studies suggest that a rather high degree of correlation exists between results from experimental animals and those from man. 684 references. (C.H.)

27401 (NAS-NRC/Pub-875) EFFECTS OF IONIZING RADIATION ON THE HUMAN HEMAPOIETIC SYSTEM. Report of the Subcommittee on Hematologic Effects—Committee on Pathologic Effects of Atomic Radiation. (National Research Council). 1961. 14p. (A/AC.82/G/L.569)

Data are reviewed on the effects of short and long-term exposure to ionizing radiation on the human hemopoietic system. It is pointed out that changes in the cellular constituents of the blood are one of the most sensitive indices of radiation injury. It is concluded that present evidence is insufficient to prove or disprove the hypothesis of a

threshold for radiation effects in man. There is no specific therapy for radiation injury but only supportive measures. Recommendations are presented for future research studies. 41 references. (C.H.)

27402 (OEG-78-II) THE EFFECTS OF RADIATION ON POPULATIONS. VOLUME II: THE SOMATIC EFFECTS OF MODERATE RADIATION LEVELS. (Office of the Chief of Naval Operations. Operations Evaluation Group). 1960. 50p.

The effects, both immediate and deferred, which exposure to ionizing radiation will have on the individuals who are themselves exposed are discussed. Twenty-five r is considered the minimum or threshold dosage for any immediate, observable, tactical effect of radiation exposure. Present evidence indicates that repeated moderate doses of radiation lead to a reduced life expectancy. Repeated exposure to 5 r or more apparently reduces life expectancy by 2 to 5 days per r. There is additional evidence that exposure to radiation increases the probability of certain specific diseases such as cancer, leukemia, and cataract of the eye. The various sources of radiation in fallout are described. It was decided that the continued detonation of 100 MT of nuclear weapons a year in the stratosphere would probably result in a reduction of the average life expectancy by about 20 days. (M.C.G.)

27403 (TID-12999) HISTOCHEMICAL AND BIOLOGICAL ALTERATIONS FOLLOWING WHOLE BODY X-IRRADIATION. Progress Report, September 1960–June 1961. (New York Univ., New York. Medical Center). Contract AT(30-1)-1680. 5p.

Charles River rats appeared to be less resistant to whole-body x irradiation than the original CFN strain. The protective effects of 5-hydroxytryptamine were studied. The effects of whole-body irradiation on capillary resistance were found to be insignificant. Data relating to blood coagulation time and platelet numbers were collected. Attempts were made to determine whether the protection afforded by "endotoxin tolerance" against lethality following whole-body x irradiation was mediated through the reticuloendothelial system. Two pentose cycle dehydrogenase systems were further analyzed. (M.C.G.)

27404 (CEA-tr-X-163) INFLUENCE DES SUBSTANCES RADIOACTIVES SUR LE DÉVELOPPEMENT ET LA CROISSANCE DES PLANTES. (Effects of Radioactive Substances on the Development and Growth of Plants). S. Przestalski. Translated into French from a paper presented at "Pierwsze Krajowe Sympozjum Poswiecone Stoswaniu Izotopow Promieniotworczych w Biologii, Medycynie, i Rolnictwie, 2 i 3 Kwietnia 1959, Warszawa." 3p.

Tests were made on the effect of low doses of radiation on plant harvest. The effect was studied by maceration of the seeds before sowing in radioactive salts and by fertilizing the plants with U ores or uranyl nitrate. In the majority of cases the plants whose seeds had been macerated before sowing developed much better in the beginning of vegetation than untreated plants. This difference disappears in proportion to the growth of the plant. (J.S.R.)

27405 THE SECRETION OF ANDROGEN BY THE X-IRRADIATED OVARY OF THE ADULT RAT. Margaret Shelton (Univ. of Birmingham, Eng.). Acta Endocrinol., 37: 529-40(Aug. 1961).

In order to determine whether the secretion of androgen by the ovary of the adult rat increases after x irradiation, irradiated ovaries were implanted into castrated male litter-mates, and pieces of prostate into both x-irradiated and normal female rats. The grafts of irradiated ovaries failed to vascularize and grow, and did not appear to secrete androgen, as judged by the weight of the accessory sex organs of the male hosts. The results of these experiments were therefore considered inconclusive. On the other hand, the structure of the prostatic grafts removed from female hosts indicated that the circulating level of androgen was higher in the irradiated than in the non-irradiated animals. (auth)

27406 METABOLIC STUDIES OF GAMMA-IRRADIATED WHEAT GROWING WITHOUT CELL DIVISION. Alan H. Haber, William L. Carrier, and Donald E. Foard (Oak Ridge National Lab., Tenn.). Am. J. Botany, 48: 431-8 (July 1961).

Wheat grains given 800 kr of Co^{60} gamma radiation before moistening can germinate and grow into small seedlings without cell division or desoxyribonucleic acid (DNA) synthesis. The growth is sustained by metabolism and is not merely water uptake. The growing seedlings increase in dry matter, protein, and ribonucleic acid (RNA). They can perform photosynthesis by fixing carbon from CO_2 into sugar phosphates, sucrose, amino acids, and organic acids. These results suggest that such irradiated cereals may be used for certain physiological and anatomical studies of germination and development in an intact growing organism in the absence of DNA synthesis, mitosis, and cell division. (auth)

27407 ANATOMIC STUDIES OF GAMMA-IRRADIATED WHEAT GROWING WITHOUT CELL DIVISION. Donald E. Foard and Alan H. Haber (Oak Ridge National Lab., Tenn.). Am. J. Botany, 48: 438-46(July 1961).

A morphological and histological study was made of wheat seedlings growing without desoxyribonucleic acid (DNA) synthesis, mitosis, and cell division after gamma irradiation of the grain. The development of the seedlings parallels the normal development of unirradiated wheat in correlative growth of primordia and organs and in the production of highly differentiated cell and tissue types. The absence of cell division makes these seedlings differ from unirradiated plants in several respects: no initiation of new organs; abnormal maturation of regions corresponding to the meristems: and greater cell lengths. Guard cells, subsidiaries, and hair-bearing cells are lacking, except in the apical 2–3 millimeters of the first leaf. Anatomic similarities of these plants to those treated with maleic hydrazide, including maturation to the tip of the roots, are discussed. The central cylinder of the upper pair of lateral seminal root primordia becomes highly differentiated with negligible elongation of the primordia. The occurrence of a high degree of differentiation after doses of radiation that produce extensive chromosome breakage indicates that in the absence of mitosis the chromosomes need not remain intact for the cells to continue differentiation. Such seedlings can be used to indicate the capacities of the cells in the embryo for differentiation without DNA synthesis, mitosis, and cell division. (auth)

27408 STUDIES ON THE EFFECT OF CARBON DIOXIDE ON X RAY-INDUCED CHROMOSOME ABERRATIONS IN TRADESCANTIA. II. RELATION TO DOSE RATE AND ENVIRONMENT DURING IRRADIATION. Leo E. LaChance (Brookhaven National Lab., Upton, N. Y.). Am. J. Botany, 48: 489-92(July 1961).

The effect of carbon dioxide on radiation-induced chromosome aberrations was investigated to determine its relation to dose rate and the efficacy of a pretreatment followed by x irradiation in nitrogen or in vacuo. Carbon dioxide and air, present during the radiation treatment,

significantly increase the frequency of chromosome aberrations induced by 300 r of x rays through a 46-fold difference in dose rate. Pretreatment with CO_2 and air also increases the aberration frequency if the radiation occurs in air. Pretreatment is completely ineffective when the inflorescences are irradiated in vacuo or in nitrogen. Thus it appears that CO_2 acts synergistically with oxygen in increasing the frequency of chromosome aberrations induced by x rays. (auth)

27409 UNUSUAL BONE TUMORS AFTER ROENTGEN THERAPY OF CHILDREN. Two Case Reports. Jonathan Cohen and Giulo J. D'Angio (Children's Cancer Research Foundation, Boston; Children's Hospital Medical Center, Boston; and Harvard Medical School, Boston). Am. J. Roentgenol., Radium Therapy Nuclear Med., 86: 502-12 (Sept. 1961).

In a selected series of 207 children who received x-ray therapy with 1000 r or more delivered to bone, 2 subsequently developed neoplasms of bone. Both bone tumors occurred in normal ribs included in the field of treatment. The tumors were atypical; one resembled a chondrosarcoma, the other an osteoblastoma. The latent periods were thirteen and two years, respectively. Both children had postirradiation scoliosis and hypoplasia of the ilium. One also developed an osteochondroma of the ilium. (auth)

27410 EVIDENCE FOR RADIATION AND CHEMICALS AS LEUKEMOGENIC AGENTS. Eugene P. Cronkite (Brookhaven National Lab., Upton, N. Y.). Arch. Environmental Health, 3: 297-303(Sept. 1961). (BNL-5299)

Both single and prolonged exposure to x ray and γ rays was demonstrated to produce an increase in the incidence of leukemia in man. There is no reason to question the leukemogenic capacity of all types and energies of radiation irrespective of the source, providing that the hemopoietic tissues are irradiated. After single doses of penetrating x rays or gamma rays, reasonable estimates of the increased incidence of leukemia to be expected can be made. Comparable estimates after chronic exposure, intermittent exposure, and deposition of radioisotopes in the bone cannot be made. Many chemicals and drugs were shown to be capable of inducing leukemia in animals. Of all the toxic agents to which man is exposed in industry, a reasonable cause and effect relationship was established only for benzol. The absence of a positive correlation of leukemia induction with other toxic agents a "clean bill of health," since all carcinogenic processes are statistical, and the unequivocal demonstration of a small effect may necessitate a sample size in excess of 10^5. Such an exposed group is a rarity, even in huge industries. When a positive effect is demonstrated in a small group the hazard is relatively great. The leukemia burden from toxic influences in industry remains unknown, but its sum throughout industry could be significant. Continuous surveillance for an effect and increasing protection against all known leukemogens is essential. Any drug or chemical capable of inducing bone marrow damage must be assumed to be potentially a leukemogen. (auth)

27411 EFFECT OF γ-RAYS UPON FOOD MICROORGANISMS. IV. STUDIES CONCERNING INFLUENCES OF AMINOACIDS AND PROTEIN MATERIALS UPON SURVIVAL OF ESCH. COLI BY γ-RAY IRRADIATION. W. Watanabe (Univ. of Tokyo and Niko Institute of Food, Niko Co., Ltd., Tokyo). Bull. Agr. Chem. Soc. (Japan), 24: 75-83(1960). (In English)

The effects of aminoacids and protein materials on the survival of Co^{60} γ irradiated Esch. coli. were investigated. A comparison was made of the survival curves obtained with media containing each of the 15 kinds of aminoacids and 3 different protein materials. (Abstr. Japan Med., 1: No. 10, 1961).

27412 EFFECT OF γ-RAYS UPON FOOD MICROORGANISMS. V. STUDIES ON THE SURVIVAL OF ESCH. COLI IRRADIATED WITH γ-RAYS. W. Watanabe (Tokyo Univ. and Niko Inst. of Food, Niko Co., Ltd., Tokyo). Bull. Agr. Chem. Soc. (Japan), 24: 84-92(1960). (In English)

The effects of various environmental conditions on the survival of E. coli irradiated with γ rays were studied. The minimum γ-ray dose rate necessary for regular survival of the strain under a weak γ-ray field in 3 kinds of media, influences of the vacuum procedure, and the effects of some other conditions were determined. (Abst. Japan Med., 1: No. 10, 1961).

27413 ENHANCEMENT OF THE OVER-ALL LETHAL EFFECT OF IONIZING IRRADIATION ON MICROORGANISMS BY SODIUM CHLORIDE. Y. Okazawa, M. Namiki, S. Yamashita, and A. Matsuyama (Tokyo Univ.). Bull Agr. Chem. Soc. (Japan), 24: 235-42(1960). (In English)

The over-all lethal effect of irradiation on microorganisms was enhanced by NaCl. The fact that this phenomenon of radiation enhancement was observed in the case of cells which gave the one-hit type survival curve suggested that radiation damage responsible for this phenomenon was not restricted to biological targets. (Abstr. Japan Med., 1: No. 10, 1961).

27414 THE MECHANISM OF RADIATION ENHANCEMENT OF THE LETHAL EFFECT OF SODIUM CHLORIDE ON MICROORGANISMS. Y. Okazawa, M. Namiki, and A. Matsuyama (Tokyo Univ.). Bull. Agr. Chem. Soc. (Japan), 24: 435-43(1960). (In English)

In order to elucidate the radiation damage of cell constituents and its enhancement by NaCl, isotope experiments were carried out with cells of S. cerevisiae, Z. soya, and E. coli. The mechanism possibly involves an increase in cell permeability by irradiation followed by increasing penetration of NaCl, which results in denaturation of the critical cell constituents. Thus, the sensitivity of irradiated cells to NaCl may increase. The NaCl sensitive sites are not considered to be restricted to the biological targets for radiation. (Abstr. Japan Med., 1: No. 10, 1961).

27415 EFFECT OF γ-IRRADIATION ON THE ADRENOCORTICAL FUNCTION OF RATS. G. Miyake, T. Setsuda, and H. Muranaka (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 37: 468(1959).

Following Co^{60} irradiation of 900 r, rats treated with ACTH survived 12.3 days while those without treatment lived only 8.3 days. On the second day the weight of the adrenal cortex was still within normal limits, but it tended to increase by the 4th day. At 4 hours after irradiation the ability of adrenocortical steroidogenesis in vitro was increased above normal, followed by a decrease 2 days later. When ACTH was injected after irradiation the excretion of formaldehydogenic steroids was lower than normal 2 to 5 days later. The decrease of WBC started 4 hours after irradiation, reaching 90% on the 4th day. Eosinophilic leukocytes almost disappeared immediately following irradiation. (Abstr. Japan Med., 1: No. 10, 1961).

27416 THE DOSE-RESPONSE RELATION IN RADIATION-INDUCED CANCER. A. C. Upton (Oak Ridge National Lab., Tenn.). Cancer Research, 21: 717-29(July 1961).

Although ionizing radiation can apparently induce neoplasms of virtually all types, the relation between tumor

incidence and dose varies, depending on the type of neoplasm, constitution of the host, conditions of irradiation, and other variables. Owing to statistical limitations, however, the existing data fail to provide an unambiguous picture of the dose-response relation for any form of cancer. More adequate data are, therefore, needed not only for estimating the hazards to be expected from small doses of radiation but for analyzing the mechanism of carcinogenesis. (auth)

27417 LYMPHOMATOSES INDUCED IN THE HAMSTER EXPOSED TO X RAYS. M. R. Riviere, I. Chouroulinkov, and M. Guérin (Institut de Recherches sur le Cancer, Villejuif, France). Compt. rend. soc. biol., 155: 37-9 (1961). (In French)

Hamsters exposed to whole-body x radiation showed a significant percentage of lymphomatoses. The hamster appears to behave in a manner identical to that of other rodents, particularly the mouse. The presence of viruses in the tumors was not demonstrated. In addition to lymphosarcomas, other neoplasms were observed, but it could not be affirmed that their development was the result of the irradiation. (tr-auth)

27418 THERAPEUTIC EFFICACY, ON MICE IRRADIATED WITH X RAYS, OF BONE MARROW FROM ISOLOGOUS ANIMALS, PREVIOUSLY TREATED WITH CORTISONE. J. F. Duplan and P. Monnot (Institut du Radium, Paris). Compt. rend. soc. biol., 155: 45-8(1961). (In French)

The repeated injection of cortisone (0.75 mg six times) into mice causes in the bone marrow a decrease by half of the number of granulocytic cells apt to be multiplied (myeloblasts, promyelocytes, and myelocytes). Consequently this marrow loses a large part of its restorative activity when it is injected into isologous mice irradiated with a 100% lethal dose of x rays. (tr-auth)

27419 CARDIO-VASCULAR MALFORMATIONS PROVOKED IN THE CHICKEN AFTER IRRADIATION WITH X RAYS OF THE EMBRYONIC REGION LOCATED BEHIND THE HEART RUDIMENT. Nicole Le Douarin (College de France, Paris). Compt. rend. soc. biol., 155: 61-4 (1961). (In French)

The x-ray destruction of the embryonic region intended to form the neck modifies the topographic ratios of the cardiac rudiment, causing a constraint in the normal pattern of morphogenetic movements. Malformations of the heart and the arterial trunks result. The cardio-vascular malformations are, moreover, more frequent and significant when the anterior radiation level is nearer the heart and when the region destroyed is wider. The vascular anomalies concern generally the brachiocephalic trunks and less frequently the aortal bend. The heart malformations affect the rotation of the arterial bud and the achievement of cardiac partitioning. (tr-auth)

27420 EFFECT OF TRYPTAMINE AND 5-HYDROXYTRYPTAMINE ON THYMOCYTES IRRADIATED IN VITRO. G. Booz and E. H. Betz (Université, Liège). Compt. rend. soc. biol., 155: 197-9(1961). (In French)

The protective effects of tryptamine and 5-hydroxytryptamine against x irradiation of thymocytes in vitro were studied. Neither substance gave any protection. Since both offer good protection in vivo, it is suggested that they do not act directly to protect the cells in vivo, but operate in an indirect manner, perhaps by modifying the local circulatory conditions and thus the conditions of tissue oxygenation. (J.S.R.)

27421 A COMPARATIVE ANALYSIS OF THE POST-RADIATIONAL RECUPERATION OF DIPLOID YEAST IRRADIATED WITH ALPHA AND GAMMA RAYS. V. Bilushi and V. I. Korogodin (Inst. of Radiology and Physical-Chemical Biology, Academy of Sciences, USSR and Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 138: 1208-11(June 11, 1961). (In Russian)

It had been found that in the irradiation of cells having a minimum of two sets of chromosomes (yeast cells) by gamma rays, the survival of these cells increases significantly after incubating in a non-nutrient medium. This recuperative effect can be represented by a process rate β and a coefficient of irreversibility k according to the equation: $D_t = D_0[k + (1 - k)e^{-\beta t}]$, where D_t is the effective dose after t hours and D_0 is the dose administered. The coefficient of irreversibility k indicates the fraction of absorbed radiation energy which causes irreversible changes in the cells. Yeast cells, Saccharomyces vini of the strain Megri-139 B, were irradiated at 1 to 2°C for 1 to 22 hours with alpha particles of Pu^{239}. Samples of the yeast cells were counted immediately after irradiation, and also 24 and 48 hours later. On plotting the log of the survival of the yeast cells versus the fraction of the dose at 50% survival, the values of k_α and k_γ were found to be independent of dose, and were equal to 0.38 ± 0.014 and 0.41 ± 0.023 respectively. Thus, the irreversible damage undergone by the diploid yeast cells is practically the same for gamma irradiation and alpha irradiation. An acceptable model is one consisting of many targets which are struck individually by radiation. Since, with alpha radiation, thousands of ion pairs are formed within a path length of 1 μ, the cross-section of the target undergoing damage is of the order of tens of angstroms which are the dimensions of a number of proteins and nucleoproteins. (TTT)

27422 EXPERIMENTAL ANALYSIS OF THE ACTION OF RADIATION ON CELL NUCLEI IN CULTURES OF HUMAN EMBRYONIC TISSUES. N. P. Dubinin, Yu. Ya. Kerkis, and L. I. Lebedeva (Inst. of Cytology and Genetics, Siberian Branch, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 1212-15(June 11, 1961). (In Russian)

Since it had been previously demonstrated that the changes of cell nuclei in irradiated Ateles apes are close to those observed in young tissue cultures, it is believed that valuable information about the effects of small doses of radiation on the human body and the dose required to double the natural mutagenic frequency in humans could be obtained by comparing the natural mutagenic rate with the observed mutagenic rate in human tissues subjected to small doses of radiation. A concentrate of 300,000 cells per ml was recovered from two-month old human embryos, and 2 ml samples were irradiated with single x-ray doses of 10, 25, and 50 r. The induced chromosomal rearrangements were determined under a microscope 42 to 49 hours after irradiation. After subtracting the natural mutagenic rate, the frequency of induced chromosomal changes was found to be 1.2% at 10 r, 5.7% at 25 r and 11.8% at 50 r. The average mutation rate is 0.19% per 1 r of dose. These data indicate that human cell nuclei are much more radiosensitive than they were thought to be previously. The natural mutation rate is doubled at a dose of about 10 r. In view of the importance of the conclusions drawn from these experiments, it was decided to repeat the experiments by giving the cells smaller x-ray doses of 5 r, 7 r and 10 r. The results of this second series of experiments again showed that the natural mutation rate is doubled at a dose of almost 10 r. It is pointed out that there are many mutagenic changes which are not detected under the microscope,

and hence, that the over-all mutagenic rate must be even larger than that found experimentally. The increase in radiation background resulting from nuclear explosions is viewed with alarm. (TTT)

27423 RADIATION AND AGING. Synopses of Panel Discussions Held During 1958 and 1959. Philip Handler, ed. Federation Proc., 20: No. 2, Pt. 2, Suppl. No. 8, 1-46(July 1961).

Separate abstracts have been prepared on the 7 papers presented. (C.H.)

27424 SIMILARITIES BETWEEN PHYSIOLOGIC AND RADIOLOGIC ACCELERATED AGING. Thomas F. Dougherty (Univ. of Utah, Salt Lake City). Federation Proc., 20: No. 2, Pt. 2, Suppl. No. 8, 3-7(July 1961).

Similarities between physiologic and radiologic aging are discussed from the standpoint of the role of cellular damage, cellular repopulation, alterations in blood volume as a result of radiation and aging, and biological time clocks. It was concluded that the margin of organ or tissue reserve is smaller in older individuals and possibly also in chronically irradiated animals. (C.H.)

27425 BIOCHEMICAL CONSIDERATIONS OF RELATIONSHIPS BETWEEN EFFECTS OF TIME AND OF RADIATION ON LIVING SYSTEMS. Philip Handler (Duke Univ., Durham, N. C.). Federation Proc., 20: No. 2, Pt. 2, Suppl. No. 8, 8-13(July 1961).

The fundamental aspects of aging are discussed from the standpoint of biochemical relationships between the effects of time and radiation on living systems. Several possibilities are discussed. It is concluded that the apparent relationship between the influence of the delayed effects of radiation on life expectancy and the normal aging process is completely fortuitous. The influence of radiation appears most likely to operate by lodging in somatic cells defects in the genetic structure which provide the information for protein biosynthesis and defects, the expression of which results in cell death. Aging appears also to be a consequence of cell death with failure of replacement. The biochemical mechanisms underlying the time-dependent loss of the cellular mass of a multicellular animal appear to be of a different nature than those which are operative in the irradiated animal. (C.H.)

27426 PHYSIOLOGIC AGING AND RADIOLOGIC LIFE-SHORTENING. Laurance W. Kinsell (Inst. for Metabolic Research, Oakland, Calif.). Federation Proc., 20: No. 2, Pt. 2, Suppl. No. 8, 14-21(July 1961).

Definitions of the state of physiological aging are discussed. Topics discussed include the relationship of physiologic aging and radiologic life shortening as observed during hematopoiesis, in the cardiovascular system, in the crystalline lens, and in the liver, kidney, lungs, muscle, central nervous system, skeleton, skin, endocrine system, and lymph system. It is concluded that radiation, in common with many other physical agents, if used in sufficient amount, can produce in any cell, tissue, or organ a state in which catabolism goes on at a greater rate than anabolism. Depending upon the nature of the cell, the cellular environment, and the quantity and quality of radiation, a variety of effects are produced ranging from slight changes in functional capacity of the cell to inhibition of mitotic activity, inhibition of measurable chemical activity, modification of structural composition, and complete dissolution of the cell. (C.H.)

27427 MEANING OF EXPERIMENTAL METHODS OF CHANGING RATE OF AGING, WITH SPECIAL REFERENCE TO LATE EFFECTS OF RADIATION EXPOSURES. Ralph W. Brauer (U. S. Radiological Defense Labs., San Francisco). Federation Proc., 20: No. 2, Pt. 2, Suppl. No. 8, 22-5(July 1961).

The course of aging in man is shown to be subject to considerable modification in the direction both of lengthened and of shortened life expectancy. Various signposts of aging are discussed and compared with effects observed after exposure to radiation. (C.H.)

27428 ESTIMATION OF RADIATION EFFECTS AT SMALL EXPOSURES. Hardin B. Jones (Univ. of California, Berkeley). Federation Proc., 20: No. 2, Pt. 2, Suppl. No. 8, 26-8(July 1961).

Problems involved in the estimation of the physiologic effects of low-level irradiation are discussed. It is pointed out that, at the present time, knowledge of latent radiation effects is virtually limited to the higher ranges of exposure. It is postulated that further study of the contrast between radiation effect and aging may not lead to a true segregation of the two. (C.H.)

27429 CELLULAR ASPECTS OF IRRADIATION AND AGING IN MAMMALS. T. T. Puck (Univ. of Colorado, Denver). Federation Proc., 20: No. 2, Pt. 2, Suppl. No. 8, 31-4(July 1961).

The processes of aging and radiation injury share a number of apparently fundamental parallelisms. The mortality rate of a population which has aged or has suffered significant exposure to low-level doses of ionizing radiation increases in a fashion which is a direct function of the amount of aging or irradiation experienced. In both cases it is impossible to find any particular organ, tissue, or physiological function in which a primary defect has been lodged, but rather there seems to be a generalized loss of physiological efficiency in many or most tissues. The action of both agents is accompanied by an increase in the frequency of malignancy. Newly developed cytologic techniques are outlined, and their use in studies of the response to the action of ionizing radiation at the cellular level is discussed. Results are included from some preliminary studies. (C.H.)

27430 GENETIC ASPECTS OF RADIATION INJURY AND PROCESSES LEADING TO NORMAL SENESCENCE. GENETICS PANEL REPORT. John W. Gowen (Iowa State Univ. of Science and Tech., Ames). Federation Proc., 20: No. 2, Pt. 2, Suppl. No. 8, 35-45(July 1961).

Some genetic aspects of senescence and the effects that irradiation may have in accelerating life-shortening are considered. Topics discussed include factors associated with spontaneous senescence, inheritance patterns, developmental sequences, somatic mutations and crossing over, chromosome breakage, cytoplasmic-nuclear interactions, the variability of random and inbred populations under irradiation, and irradiation and phenocopies. (C.H.)

27431 RADIATION INJURY AND SHOCK. Douglas E. Smith (Argonne National Lab., Ill.). Federation Proc., 20: No. 2,Pt. 3, Suppl. No. 9, 158-65(July 1961).

A comparison is made of acute radiation syndrome and shock syndrome. It is pointed out that a number of biochemical, functional, and morphological changes occur in both conditions. These are discussed in detail. (C.H.)

27432 AN ATTEMPT TO ESTIMATE THE INDUCTION BY X-RAYS OF RECESSIVE LETHAL AND VISIBLE MUTATIONS IN MICE. T. C. Carter and Mary F. Lyon (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). Genet. Research, 2: 296-305(July 1961).

The experiment was designed to form a bridge between the results of specific-locus experiments, using only a few gene loci, and those using the whole genome of the mouse. Male mice were given 600 r acute x rays and bred in such a way that at successive stages mutation in spermatogonia to dominant visibles and lethals, dominant semisteriles, recessive visibles, and recessive lethals could be measured. The data concerning dominant mutations were relatively few but confirmed previous results. No recessive visible mutations were found, and the upper fiducial limit to the induced mutation rate to recessive visibles was set at a value 4500 times the rate to viable specific-locus mutations. From the attempt to measure recessive lethal mutations two interesting points emerged. The first was that granddaughters of the irradiated males had fewer corpora lutea per pregnancy than granddaughters of the control males, and the second was that this difference in number of ova shed was not reflected in any difference in litter-size at birth. Since this suggests intra-uterine compensation, no attempt was made to calculate mutation rates to recessive lethal genes from these data. The implications of the results are discussed. (auth)

27433 INDUCED MUTATIONS AT THE V^{by} LOCUS OF TRIFOLIUM REPENS. II. REDUCTION BELOW THE ADDITIVE BASE LINE BY FRACTIONATED DOSES OF GAMMA RADIATION. D. Roy Davies and E. T. Wall (Wantage Research Lab., Berks, Eng.). Genetics, 46: 787-98 (July 1961).

Dose-fractionation was shown to have a pronounced effect on the number of mutations produced but none on leaf production. Dose fractionation led to a reduction in the number of mutations recovered to a value below the expected base line of the additive effects of the two fractions. The development of the protective effect was dependent on time, being at a maximum at 2 to 8 hours at 25°C; on temperature, taking longer to develop at 8°C than at 25°C; and on dose, being greater at higher doses. With high temperatures the effect diminished after long intervals, but persisted at lower temperatures. Doses as low as 12.5 rads induced protection, and the phenomenon developed within a very short period post-irradiation. Protection occurred only if the initial fraction was given in the presence of oxygen. The protective effect observed could be attributed to mitotic delay and the presence of a sensitive stage in interphase for the induction of some point mutations. Attempts were made to correlate the observations with the known effects of radiation on DNA synthesis. (auth)

27434 TEMPERATURE EFFECTS ON LETHAL MUTATION RATES OF HABROBRACON OŏCYTES X-IRRADIATED IN FIRST MEIOTIC METAPHASE. Anna R. Whiting (Oak Ridge National Lab., Tenn. and Univ. of Pennsylvania, Philadelphia). Genetics, 46: 811-16(July 1961).

Unmated females of Habrobracon were irradiated with 1263 and 1444r at high and low temperature before, during, and/or after irradiation. A significant lowering of lethal changes induced in oŏcytes x irradiated in first meiotic metaphase (LD 50 about 400r) at low temperatures before and after exposure as measured by hatchability of unfertilized eggs was observed. Low temperature during irradiation ($1\frac{1}{2}-2$ minutes) did not significantly change survival rate although there is a suggestion of a tendency toward increased lethality. Theories are discussed as to the cause or causes of differential sensitivity of cells and the relation of the sensitivity to oxygen and temperature. (auth)

27435 X-RAY EFFECTS ON EMBRYOS OF THE PARADISE FISH, WITH NOTES ON NORMAL STAGES. A. Lester Allen and Lewis M. Mulkay (Brigham Young Univ., Provo, Utah). Growth, 24: 131-68(1960).

Embryos of the paradise fish were exposed to x rays at different stages of development. Histologic studies were made of several selected organ systems in order to determine the stages at which particular anomalies might be induced. In each organ system certain anomalies were characteristically produced by irradiation at specific developmental stages. In most cases the abnormalities were induced by exposure prior to visible differentiation of the anlagen of the affected structures. Both susceptibility to radiation damage and the ability to regenerate from the damaged condition are directly proportional to the mitotic index of the tissues at the time of and following exposure. Differentiation processes are also susceptible to damage but, when unaccompanied by active mitosis, have less regenerative capacity. Some notes on normal development are also presented. Macropodus differs from the typical teleostean patterns of development in the ear and the gut. The otocyst arises by cavitation of a cranial crest mass which is attached to neutral ectoderm. The gut lumen forms by cavitation of a longitudinal rod of cells rather than by ventral folding of an entodermal plate. (auth)

27436 THE EFFECT OF GAMMA IRRADIATION ON THE SEX RATIO OF MELANDRIUM SPECIES. D. R. Davies and E. T. Wall (Wantage Research Lab., Harwell, Berks, Eng.). Heredity, 16: 131-6(May 1961).

No correlation was found to exist between percentage germination and percentage females. The populations differed in terms of the percentage females and differences also occurred between genotypes within populations. In most instances there was a tendency for an increase in the proportion of females with increasing dose. Control progenies differed significantly from irradiated progenies, but no dose x population or dose x within population interaction existed. Since all populations responded in a similar manner, the data were bulked and the over-all means are plotted against dose. (P.C.H.)

27437 STUDY ON APPENDICITIS PATIENTS WHO HAD BEEN IN THE VICINITY OF THE ATOMIC BOMB. Y. Kurihara (Hiroshima Civil Hospital). Hiroshima Igaku, 12: 758(1959).

Patients (163) who were near the bomb center and developed appendicitis 7-13 yr after the bombing were studied. The differences between them and unexposed appendicitis patients in the hospital were not great. The male/female ratio was 1:3. The ratio of acute to chronic cases was 8:7. It was 3:1 in all appendicitis patients of the hospital. The number of leukocytes differed from case to case, but it seemed that the tendency to leukocytosis was weak. There was little difference between those who were indoors and those who were outside at the time of the explosion. At the time of the bombing the severity of all symptoms was related to distance of the patient from the explosion. However no correlation was established between the distance the patient was from the epicenter and the pathological findings in the appendix or the leucocyte response. (Abstr. Japan Med., 1: No. 10, 1961)

27438 STUDIES ON THE γ-RAY IRRADIATION ON PROTEIN. I. EFFECT ON THE SULPHYDRYL GROUPS, POLAROGRAPHIC PATTERNS AND ELECTRON SPIN RESONANCE ABSORPTION OF BOVINE SERUM ALBUMIN. Y. Imai (Kyoto Univ.). J. Biochem. (Tokyo), 49: No. 2, 85-90(1961).

Using a Co^{60} γ-ray source (intensity 3×10^3 r per hour), the effects of irradiation on bovine serum albumin in the

dissolved or solid states were studied by amperometric titration of -SH groups, polarographic protein wave recording, and paramagnetic resonance absorption spectroscopy. The content of -SH groups was decreased when a protein solution was irradiated, especially in the presence of air, while hardly any reduction was observed on the solid samples in the absence of air. Such a decrease of -SH groups would result from oxidation. Increase in the amount of -SH groups observed on the solid samples irradiated in the presence of air could be attributable to the secondary configurational changes of molecules. Marked changes of polarographic patterns of protein double waves were observed on both dissovled and solid samples, and their time course or correlation with dose of radiation was studied. These changes in protein waves did not always run parallel with those in the content of titrable -SH groups. (Abstr. Japan Med., 1: No. 10, 1961).

27439 EFFECTS OF X-RAY AND β-RAY IRRADIATION ON THE OCCURRENCE OF EXPERIMENTAL CARCINOMA OF MICE. M. Yokoi (Kanazawa Univ., [Japan]). Kanazawa Irigaku Sosho, 53: 1-20(1959).

When 0.3% 3:4-benzpyrene was dripped onto adult mice, skin papilloma occurred in 20.7% and carcinoma in 67.9% of the animals. X irradiation with x-rays in total doses of 1600 to 2000 r caused the tumors to decrease slightly in size and the cancer cells, especially in the peripheral part, to degenerate. After irradiation with 25 and 50 μc of Sr^{90}, degeneration of several cancer cells in the mitotic phase was observed in the superficial part of the tumor, but no change was noted in the deep part. The development of the carcinoma was strikingly inhibited and delayed by single prophylactic whole-body x irradiation before benzpyrene application. Development of the tumor was completely inhibited by prophylactic fractional whole-body irradiations. These results suggest that a substance was produced by x irradiation which suppressed the development of the carcinoma. (Abstr. Japan Med., 1: No. 10, 1961)

27440 EXPERIMENTAL RESEARCH ON THE RADIOPROTECTIVE ACTIVITY OF NEW DITHIO DERIVATIVES. R. Paoletti and R. Vertua (Universita, Milan). Minerva nucleare, 5: 68-71(Apr. 1961). (In Italian)

Several new dithio derivatives were tested as radioprotective agents on the survival time of irradiated mice and on the decrease in the concentration of DNA in the small intestine of mice after irradiation or nitrogen mustard treatment. Three compounds, morpholin-dithioformate of morpholine, 2-methyl-piperazine-dithioformate, and pyrrolidin-dithioformate of pyrrolidine, showed a similar or greater radioprotective activity than cysteamine under the same experimental conditions. (auth)

27441 HAEMATOLOGICAL AND HISTOLOGICAL STUDIES IN THE OFFSPRING OF ALBINO RATS AFTER Sr^{90} ADMINISTRATION. I. HAEMATOLOGICAL AND HISTOLOGICAL OBSERVATIONS IN THE ALBINO RATS AFTER Sr^{90} ADMINISTRATION. K. Nishimura (Kyoto Univ.). Naika Hokan, 6: 540-53(1959).

No appreciable hematological changes were seen following a single injection of Sr^{90} in a dose of 0.2 μc/g of body weight. A single dose of 0.5–1.5 μc of Sr^{90} or successive injections of 0.2 μc for 5 weeks resulted in a marked decrease of neutrophilic leukocytes, as well as the delayed decrease of the lymphocytes and thrombocytes; the erythrocytes were influenced the least. The deposition of Sr^{90} 12 months later was shown to be mostly in the bone and a little in the other viscera. Osteogenic sarcoma developed in the epiphysis of the femur and the humerus of 3 rats out of 12. The animals are still surviving more than 6 months after the injection of Sr^{90}. (Abstr. Japan Med., 1: No. 10, 1961)

27442 PLANT GROWTH IN IRRADIATED SOIL. G. D. Bowen and A. D. Rovira (Commonwealth Scientific and Industrial Research Organization, Adelaide). Nature, 191: 936-7(Aug. 26, 1961).

A comparison is made of the growth of subterranean clover in two soils, Urrbrae red-brown earth and Mount Compass podzolized sand, sterilized by heat, propylene oxide, and irradiation. Plating of the soil at both planting and harvesting showed that heat and irradiation treated soils were sterile, whereas the soils treated with propylene oxide were not. In both Urrbrae red-brown earth and Mount Compass sand, plant growth and development in soils sterilized by heat or propylene oxide was retarded. By contrast, plant growth in irradiated soil was good and only slightly less than that of plants growing in unsterilized soil. In irradiated Mount Compass sand, roots and root hairs were well developed. While no obvious stunting of roots occurred in irradiated Urrbrae red-brown earth, root hairs were short and sparse compared with those on plants in unsterilized soil. (P.C.H.)

27443 RADIATION SENSITIVITY OF ESCHERICHIA COLI TO β-RAYS IN DRY AND WET CONDITION. S. B. Bhattacharjee and N. N. Das Gupta (Saha Inst. of Nuclear Physics, Calcutta). Nature, 191: 1015-17(Sept. 2, 1961).

The idea that as the asymmetry of the target increases, the diffusion distance decreases, was applied to the calculation of diffusion distance for the inhibition of colony formation by E. coli exposed to β rays from Sr^{90}. Dose-survival curves are given which show that the 37% survival dose in dry condition is 20000 rads and in the wet condition 6000 rads. Some discussion is also given on the mechanism of the inhibition of division by radiation. (P.C.H.)

27444 CHANGES IN THE SERUM TRANSAMINASE AFTER TOTAL BODY IRRADIATION. V. Volek and Z. Dienstbier (Charles Univ., Prague). Neoplasma, 8: No. 1, 40-4(1961). (In English)

Changes of the serum glutaminpyruvic transaminase in rabbits after whole-body exposure to 800 r were followed. The data of the first 4 days after irradiation were anzlyzed. An increase in the activity of the enzyme was found 12 hours after irradiation. It was concluded that the slight elevation of SGPT in rabbits is caused by the early damage of the liver cell, however, the test cannot be employed for biological studies of the importance of post-irradiation damages of the liver. (P.C.H.)

27445 THE EFFECT OF Cr^{51} ON YOSHIDA ASCITES SARCOMA CELLS. E. Endo, M. Tanaka, S. Tsukahara, T. Tsukahara, T. Hiruma, S. Hasegawa, T. Kojima, and I. Asaoka (Nihon Univ., Tokyo). Nichidai Igaku Zasshi, 18: 2276-84(1959).

On the 4th day after implantation of Yoshida ascites cell sarcoma, 200 μc and 100 μc of $Cr^{51}(Na_2Cr^{51}O_4)$ were injected into the abdominal cavity of rats, and cytological study on the tumor was performed. The cells in the ascites were fixed in methanol and stained with Giemsa stain. Cell division was inhibited by the injection of Cr^{51}. The more radioactive the injected Cr^{51}, the more inhibited was the mitosis. The cells in the prophase and metaphase were decreased, but, on the other hand, the number of the abnormal cells was remarkably increased. (Abstr. Japan Med., 1: No. 10, 1961)

27446 STUDIES ON THE COMBINED EFFECT OF RADIATION AND VARIOUS CHEMICALS ON MITOTIC CELLS. XIV. EFFECT OF THE COMBINED USE OF X-RAY AND ACRIFLAVINE. H. Kurosaka (Hokkaido Univ. School of Medicine, Sapporo). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1217-26(1959).

The effect on sarcoma cells of acriflavine, alone and combined with radiation, was tested. The material used was MTK sarcoma 111 of rats. An aqueous solution of acriflavine was injected intraperitoneally, and the frequency of mitosis, the percentage of each mitotic phase, and the frequency of abnormal chromosomes in the metaphase and anaphase were determined. The frequency of mitosis diminished rapidly after the administration of acriflavine, being lowest 3 to 6 hr after injection. Then the number of mitotic cells gradually increased, but it was not restored to the pre-treatment condition even 48 hr after injection. The decrease in mitoses was proportional to the amount of acriflavine injected, ranging from 0.1 mg/100 g to 2.5 mg/100 g. Abnormal chromosomes with stickiness and condensation were found in the metaphase, while in the anaphase chromosome-bridges induced by stickiness were definitely increased. When combined with x ray the number of mitoses in sarcoma cells was even fewer. When small amounts of acriflavine (up to 0.005 mg/100 g) were administered before or after irradiation, mitosis of sarcoma cells was depressed, although no recognizable effect occurred when such small amounts were used without x irradiation. (Abstr. Japan Med., 1: No. 10, 1961)

27447 STUDY ON THE EFFECT OF X-RADIATION UPON PLATELETS AND MEGAKARYOCYTES. [PARTS] I AND II. T. Kitamura (Nagoya Univ. School of Medicine, [Japan]). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1553-68(1959).

Six groups consisting of 3 male adult rabbits were irradiated with a single whole-body exposure of 1600 r, 800 r, 80 r, 40 r, 30 r, and 20 r. The blood platelet count appeared significantly diminished in those exposed to more than 80 r. Those receiving over 40 r showed morphological changes such as vacuolization in the peripheral platelets as well as in platelets in the bone marrow. After exposure of 1600 r and 800 r there was a decrease in mature and senile megakaryocytes, and a temporary increase in naked-nucleus platelets in the marrow. In x-ray workers, x-ray technicians, and schoolboys the platelet counts were within normal limits. No basophilic or agranular platelets were seen in normal adults, x-ray workers, and schoolboys. However, in x-ray technicians, some increase in normocytic and vacuolized platelets (parallel with the duration of working with x-rays) and an increase in macrocytic platelets were seen. (Abstr. Japan Med., 1: No. 10, 1961)

27448 THE EFFECT OF CELL TOXIN PRODUCED BY A LARGE DOSE OF X-RAY ON THE YOSHIDA SARCOMA. J. Tanimoto (Univ. of Okayama Medical School, [Japan]). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1628-37(1959).

The toxic substance was extracted as an unsaturated fatty acid. The number of cells undergoing division decreased immediately after the injection of the toxin, reaching a minimum value one hour later and increasing thereafter. However, recovery was slow as compared with exposure to 300 r x radiation. After the injection of the cell toxin the number of karyokinetic cells was decreased in every mitotic stage, particularly up to metaphase. The number of tumor cells rapidly decreased one hour after injection of toxin, and even up to 24 hours no recovery was seen. This may be due to cessation of cell division or to destruction of tumor cells. In vitro, a marked change was observed in both resting and mitotic cells 3 hours after injection with a peak of cell destruction at 6 hours. (Abstr. Japan Med., 1: No. 10, 1961)

27449 EXPERIMENTAL STUDIES ON SILICOTIC RABBITS SUBJECTED TO X-RADIATION. III. PATHOLOGICAL APPEARANCE. T. Tedo (Tohoku Univ., Sendai). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1670-8(1959).

The experimental work was carried out as previously reported, and lungs of the dead rabbits were extracted and examined. In many animals of the control group, slight changes of silicosis were observed. Among the radiated group, conspicuous difference of the degree of development of changes of silicosis was not observed between the 1st group (radiated 50 r 10 times) and the 2nd group (radiated 100 r 5 times). (Abstr. Japan Med., 1: No. 10, 1961)

27450 DIFFERENCES IN RADIOSENSITIVITY AND RECOVERY FROM THE EFFECTS OF RADIATION BETWEEN TWO TYPES OF ASCITES HEPATOMA IN THE RAT. S. Masayama (Tokyo Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1873-81(1959).

Two new types of ascites hepatoma, AH 7974 and AH 130, were derived in the rat and transplanted successively throughout numbers of generations. The former is characterized by high resistance to nitrogen mustard compounds, while the latter is very sensitive to these chemical agents. These tumors were maintained in ascites and inoculated subcutaneously on the backs of the animals 8 to 10 days before the experiments. P^{32} (60 μc per animal) was injected intraperitoneally 1 hour before sacrifice. Preliminary experiments revealed that a pronounced depression of the uptake of P^{32} was produced by x radiation. This effect was used as an indicator in differentiating the responses of the 2 hepatomas to x radiation. Analysis of the distribution of the radioactivity into the various phosphate fractions of tumor tissues (acid-soluble, lipid, nucleic acids, and phosphoprotein phosphorus) one hour after intraperitoneal injection showed almost exclusive incorporation of P^{32} into the acid-soluble fraction. Detailed analysis of the acid-soluble fraction by ion exchange column chromatography demonstrated that about 80% of the radioactivity was present in the inorganic phosphate and 20% was distributed in other phosphorylated compounds: adenosine triphosphate, adenosine diphosphate, and adenosine monophosphate. After x radiation, the radioactivity in the inorganic phosphate was decreased. One hour after intraperitoneal administration of P^{32} almost all the radioactivity is present as inorganic phosphate and the depression of P^{32} uptake of whole tumor tissue by radiation is chiefly due to depression of incorporation of P^{32} into inorganic phosphate. The radioactivity of the whole tumor tissue one hour after the intraperitoneal injection of 60 μc of P^{32} was measured at different intervals following whole body radiation (1000 r) to the tumor-bearing animals. Comparison of the time course of inhibition and subsequent recovery was made on the 2 strains of the hepatoma. In the AH 130 hepatoma x radiation caused a pronounced inhibition of P^{32} uptake, but a rapid recovery followed by an increase of P^{32} uptake was observed about 12 hours after radiation. On the other hand, in the AH 7974 inhibition of P^{32} uptake was rather small as compared to AH 130 and slow recovery from the initial inhibition was noted. These results were discussed in relation to the fractionation of the dose in the radiotherapy of malignant tumors. (Abstr. Japan Med., 1: No. 10, 1961)

27451 A STUDY OF RADIATION SENSITIVITY. [PART] II. K. Matsumoto (Tohoku Univ., Sendai). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1915-25(1959).

To study the mechanism of acquired radioresistance in tumor cells, rat-implanted Yoshida sarcoma was treated with x rays of 200 to 500 r. Tumor cells were stained and examined from just after radiation to 180 min. later. The critical dosage was about 250 to 300 r, maximum x-ray dose causing temporary functional disturbances and no cell destruction. Yoshida sarcoma seems to acquire a slight radioresistance. The resistant cells, however, disappeared after several generations, probably due to the recessive character of the gene. The mechanism of acquired radioresistance in Yoshida sarcoma cells does not seem to be the cells themselves, but may be in the condition of the surrounding tissues. (Abstr. Japan Med., 1: No. 10, 1961)

27452 STUDIES ON LUNG INJURIES FOLLOWING ROENTGEN TREATMENT OF BREAST CANCER. H. Ichikawa and T. Arai (Chiba Univ. School of Medicine, [Japan]). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2272-89(1960).

Of 102 cases of breast cancer treated by x rays, 46 (45%) showed roentgenographic evidence of lung fibrosis. A special chest phantom was constructed to measure the dose distribution within the lungs. The highest dose in the lung, by McWhirter's technique of radiation, was 150—160% of the surface. The parts of the lung where the tissue received the highest dose were the upper, anterior, and outside parts of the radiated lung. This result was the same as indicated in the roentgenographic study. The lung radiation reaction was parallel to the skin reaction. The age had no relation to the fibrosis, but 4 cases, who had marked tuberculous calcification in their lung fields, seemed to have a tendency to produce considerable fibrosis by radiation. The symptom of pneumonitis was generally slight, and the general condition of the patients was not greatly influenced as a rule. The functional lung test showed almost normal results in the cases of grade I and grade II, but considerable injury in the cases of grade III, independent of their subjective symptoms. (Abstr. Japan Med., 1: No. 10, 1961)

27453 STUDIES ON THE COMBINED EFFECTS OF RADIATION AND VARIOUS CHEMICALS ON THE MITOTIC CELLS. XVIII. EFFECTS OF THE COMBINED USE OF CHLORPROMAZINE AND X-RAYS. M. Genma (Hokkaido Univ. School of Medicine, Sapporo, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2343-53(1960).

An experimental study was made on the root tip of the bean (Vicia faba) and MTK sarcoma III. The radiation effects were observed as 3 phenomena: the frequency of mitosis, the difference of each mitotic phase in number, and the frequency of abnormality of chromosomes during metaphase. The effect of chlorpromazine as a protective agent against lethal effects by radiation on the mouse are summarized as follows: Chlorpromazine as well as x rays caused a decrease in number of mitotic cells of the root tip of bean; Injection of the drug before x radiation showed a much stronger effect on the root tip, in decreasing its mitotic cells, than the effect of either the drug or x radiation alone. (Abstr. Japan Med., 1: No. 10, 1961).

27454 EXPERIMENTAL STUDIES ON THE EFFECT OF THE AUTOANTIBODIES, PRODUCED IN X-RAY IRRADIATED TISSUES, UPON TISSUE RESPIRATION OF KIDNEY. H. Kato (Iwate Medical College, Morioka, [Japan]). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2416-58(1960).

When the tissue components of an x irradiated left kidney were excreted into the urine, the Qo_2 values of tissues showed a temporary decrease not only in the left kidney but also in the right. When the rabbits were injected only once intravenously with the emulsion of x irradiated kidney tissues, the Qo_2 values decreased slightly for a while in the kidneys and even in the other organs. Auto-antibody, iso-antibody, and hetero-antibody to the x irradiated kidney tissues all showed inhibitory actions upon the O_2 uptake function in kidney tissues only, when injected intravenously into normal rabbits. When the production of auto-antibody to the x irradiated kidney tissues was most pronounced, the activity of the succinoxidase and cytochrome-c-oxidase was inhibited not only in the irradiated kidney, but also in the non-irradiated one. At the same period of auto-antibody production after irradiation on the left kidney, the mitochondria of the nephritic duct of the left kidney showed various changes, such as granular intumescence, irregularity of arrangement, and deficiency. The same changes were observed also in the right one. The x irradiated tissue components of kidneys temporarily affected the tissue respiration of various organs, and the auto-antibody, which was produced against these tissue components, inhibited, as an auto-cytotoxin, the tissue respiration of the kidneys. (Abstr. Japan Med., 1: No. 10, 1961)

27455 INFLUENCE OF X-RAY IRRADIATION UPON SERUM PROTEINS. Y. Shibata (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2517-36(1960).

Changes of serum proteins of x irradiated rabbits were studied by electrophoresis. When fractional irradiation was used, total protein and albumin decreased as the total dose increased. In the early period, α globuin increased and γ globulin decreased, while in the later period, α globulin decreased and γ globulin increased. More marked changes were observed after liver irradiation than after irradiation of the thigh. After a single large dose irradiation of liver or whole body, total protein and albumin decreased. The α globulin increased in proportion to the irradiation dose. The maximum effect appeared earlier as the dose was increased, and the corresponding recovery required a longer perish. The lower limit of a single body irradiation for inducing changes of serum proteins was considered to be 600 r. Changes of serum proteins of liver-irradiated rabbits were effected by vit. B_{12}, methionine, and calcium pantothenate, but not by vit. B_1. Glucose and glucuronic acid produced uncertain influences on the serum proteins of irradiated rabbits. (Abstr. Japan Med., 1: No. 10, 1961).

27456 CHROMATOGRAPHIC EXAMINATION OF γ-IRRADIATED POTATO STARCH GRANULES. A. Mishina and Z. Nikuni (Osaka Univ.). Nippon Nogei Kagaku Kaishi, 34: 150-3(1960).

Glucose, maltose, arabinose, glucuronic acid, gluconic acid, and a series of small dextrins were identified by paper chromatography of highly irradiated potato starch granules. These mono- and oligosaccharides were analyzed by anion exchange column chromatography, and glucose and maltose were determined quantitatively as main fission products. A gas chromatographic analysis of the gaseous products from starch granules after γ radiation showed the presence of hydrogen, carbon monoxide, and carbon dioxide. From these results, a part of the mechanism of degradation of starch by γ radiation is discussed. (Abstr. Japan Med., 1: No. 10, 1961).

27457 CATABOLIC MANIFESTATIONS IN Co^{60} GAMMA IRRADIATED RATS. Roger Ghys and Jean Marie Loiselle (Laval Univ., Quebec City, Can.). Nuclear-Med., 1: 414-24(1961). (In English)

The value of different criteria for evaluating the catabolic effects of Co^{60} body irradiation is investigated in the present study where animals have been exposed to doses of gamma radiation ranging from sublethal to supralethal

doses. Three different groups of criteria are under scrutiny: body weight and food intake measurements, hematocrit and platelet counts, and serum amino acids and protein fraction determinations. Micro techniques allowing for repeated determinations on each individual animal during the whole experimental period were used for all blood analyses except the serum amino acid determinations. Blood platelet counts as well as serum amino acid concentration studies proved to be the most sensitive criteria. Body weight patterns are however much simpler to establish and give a very good picture of the general radiation syndrome. The serum protein fractions as measured by paper electrophoresis do not show any significant changes in their relative distribution until the last hours prior to animal death. These catabolic effects can be either diminished or enhanced by treatment with testosterone or estradiol. Both protection and sensitization are sex dependent and apparently related to the action of these hormones on metabolism. (auth)

27458 PYREXAL AS FUNCTION TEST OF THE BONE MARROW IN FRACTIONATED AND SINGLE WHOLE-BODY IRRADIATION OF RATS. B. Chone (Universität, Heidelberg, Ger.). Nuclear-Med., 1: 425-38(1961). (In German)

In rats irradiated with sublethal fractionated doses on the total-body bone marrow, tests were executed by means of Pyrexal. The substance was injected into the tail-vein. All additional measures as anesthesia, infusions, or antibiotics were omitted to avoid an effect on the bone marrow. It was found that with an increasing radiation dose, in addition to continuous decrease in white cells, the degree of increase of the number of granulocytes after Pyrexal injection is reduced. The curve is in correspondence with the expectations on the effect of total body irradiation on the bone marrow. However, with respect to the applied total dose of 700 to 1400 r the resulting functional weakness of the bone marrow is small. This is similar for one-time irradiation. Apparently a breakdown of the regulation of leukocytes occurs only when the bone marrow is mostly destroyed 36 to 60 hours after the irradiation. The effect of the irradiation on the response of the bone marrow to Pyrexal results from a curve depending on dose and time. This allows conclusions on the applied radiation dose. (auth)

27459 PROTECTIVE EFFECT OF SULFHYDRIL BODIES ON THE RADIATION-DAMAGED SMALL INTESTINE. Johannes Pany and Milica Iovanovic (Universität, Vienna). Nuclear-Med., 1: 439-45(1961). (In German)

The changes in the resorption of calcium ions in the duodenum and jejunum in young rats were investigated following irradiation with 500 r. The influence of radiation protection substances of the SH-series on these effects was observed. Calcium-45 was used as a tracer. There is a close relation between the oxidative processes in the mucosa and the calcium resorption. SH-substances with protective action reduce the primary damage but do not exert a direct influence on the recovery processes. (auth)

27460 RADIO-INDUCED MARROW EOSINOPHILIA AND ITS MODIFICATION BY SULFHYDRIL SUBSTANCES. Alfred Staffen and Johannes Pany (Universität, Vienna). Nuclear-Med., 1: 446-8(1961). (In German)

In experiments on 500 albino rats of both sexes an eosinophilic reaction was observed in Pappenheim-stained smears of the bone marrow which is dose- and time-dependent and can be inhibited by the administration of protective substances. (auth)

27461 THE PROBLEM OF EVALUATING THE BIOLOGICAL SIGNIFICANCE OF SIGMOIDAL X-RAY INACTIVATION CURVES IN YEASTS. G. E. Magni (Università, Pavia, Italy). Nuovo cimento (10), 18: Suppl. No. 2, 221-6 (1960). (In English)

The usefulness of classical genetical techniques in resolving complex experimental sigmoidal inactivation curves is demonstrated in 3 examples: haploid-diploid, relation of ploidy to radiosensitivity, and inactivation of multispore asci. The studies show that these complex curves are useful in radiobiology where different components of lethality can be discriminated by genetical or cytological techniques. (T.R.H.)

27462 ANALYSIS OF SOME EXPERIMENTAL FACTORS WHICH INFLUENCE THE X-RAY SURVIVAL CURVE OF HUMAN CELLS CULTURED IN VITRO. G. Marin, F. Nuzzo, and L. De Carli (Università, Pavia, Italy). Nuovo cimento (10), 18: Suppl. No. 2, 227-36(1960). (In Italian)

A discussion is presented of survival curves obtained from epithelioid cells of a normal human embryo stabilized in vitro. An interpretation is presented discounting the physical aspects and the radiation sensitivity and based on the condition that in homogeneous populations the characteristics with continuous variability are distributed normally. In particular, the possibilities and limitations inherent in the evaluation of survival by colony counting are analyzed. (T.R.H.)

27463 RADIO TOXICITY OF IODINE^{131} IN DAIRY CATTLE. Nutrition Revs., 19: 237-40(Aug. 1961).

A level of 100,000 rad must be applied to the bovine thyroid before radiation damage results in general systemic effects that can be observed. Reproduction was essentially normal in animals with damaged thyroids, but milk production was drastically reduced. (auth)

27464 THE EMBRYONAL DEVELOPMENT OF THE TESTIS AND THE EFFECT OF X-RAY IRRADIATION ON IT, WITH SPECIAL REFERENCE TO THE FATE OF PRIMITIVE GERM CELLS. H. Ito (Osaka Univ.). Osaka Daigaku Igaku Zasshi, 11: 1959-68(1959).

The spermatogenesis in the fetuses and newborns of rabbits and mice was histochemically studied, and the effect of x rays was also observed. The primitive germ cells showed positive reactions for the alkali phosphatase, Unna-Pappenheim and p.a.S. tests. In the fetal testis, the primitive germ cells were most radiosensitive; interstitial large cells, germinative cells, and interstitial spindle cells followed in this order. When x rays of 200 r were given to the testis in the fetal stage about 6 to 12 days after conception, the primitive germ cells appeared to be inhibited in their maturation, but if x rays were given 13 days after conception, they degenerated. (Abstr. Japan Med., 1: No. 10, 1961).

27465 TISSUE CULTURE OF NORMAL HUMAN PLACENTA AND INFLUENCE OF X-IRRADIATION. S. Ichikawa (Osaka Univ.). Osaka Daigaku Igaku Zasshi, 11: 5159-67(1959).

The placenta obtained from women 6—10 weeks' pregnant were cultured in suspension, and consecutive phase microscope observations of the newly developed cells were compared with histochemical findings. The modes of development, which reached a maximum in 24—48 hr after start of the culture, were divided into: branched form, piled form, and membranous form. The tissue cultured for 2 days was irradiated with 2000 and 4000 r and changes of the trophoblast were examined. The changes due to 2000 r of x irradiation became prominent in 2—3 hr after irradiation, and a gradual return to normal from the histochemical and phase-microscopic standpoint occurred in 12 hr. After

4000 r x irradiation, however, an irreversible change was shown, and degenerative and necrotic lesions became dominant. A reactive stimulating state induced by x irradiation was not noted by morphological observations. (Abstr. Japan Med., 1: No. 10, 1961)

27466 EFFECTS OF X IRRADIATION ON CORN SEED. Joe H. Cherry, R. H. Hageman, Floyd I. Collins, and Donna Flesher (Univ. of Illinois, Urbana and U. S. Department of Agriculture, Crops Research Div., Urbana, Ill.). Plant Physiol., 36: 566-72(Sept. 1961).

Corn seed was irradiated with eight dosages of x rays ranging from 0 to 1000 kr. Generally, all the seeds germinated and grew at uniform reduced rates for any given dose. Both hard and soft x rays greatly suppressed seedling growth, however. The range of x-ray treatments did not give a linear effect on growth. Hard and soft x rays roughly gave comparable effects. Irradiation of seed with x rays affected reducing sugar, protein, soluble nucleotides, and RNA in a manner roughly parallel to growth. Seed x irradiation decreased the ratio of soluble nucleotides to protein; little or no change in RNA to protein was observed. These changes caused by irradiation appeared to be due to an inhibition of seedling growth. The oxidative and phosphorylative activities of mitochondria isolated from corn seedlings were measured. The mitochondria isolated from scutella and embryonic axes were affected somewhat by seed x irradiation. Most of the x irradiation effect could be explained by a reduction in seedling growth. The activities of triosephosphate dehydrogenase and aldolase were determined from extracts obtained from scutella and embryonic axes tissue. The effect appears indirect. Normally, as corn seed germinates there is a change in specific activity and activity per organ. The data obtained on these two enzymes indicated that x irradiation changes enzymatic activity by retarding the age of the plant. Respiration rates and Pacc/O ratios of excised root and mesocotyl sections were measured. X irradiation reduced respiration but enhanced phosphorylation, which again can partially be explained by a reduction in seedling growth. Studies indicated that the contents of nucleotides and RNA, and the activities of enzymes and mitochondria change with growth and development of the seedling plant. (auth)

27467 INDUCTION OF PLANT TUMORS BY ULTRAVIOLET RADIATION. Carl R. Partanen and Jane Nelson (Children's Hospital Medical Center, Boston). Proc. Natl. Acad. Sci. U. S., 47: 1165-9(Aug. 1961).

It was found that tumors can be induced in gametophytes of Pteridium aquilinum by exposing the dormant spores to ultraviolet radiation prior to germination. The tumor frequency increased linearly with dosage up to the level at which general viability of the spores was significantly affected. These ultraviolet-induced tumors were in every way comparable to spontaneously occurring ones and to those induced by ionizing radiations. (auth)

27468 ACTION OF RADIATION ON MAMMALIAN CELLS, IV. REVERSIBLE MITOTIC LAG IN THE S3 HeLa CELL PRODUCED BY LOW DOSES OF X-RAYS. Masa-Atsu Yamada and Theodore T. Puck (Univ. of Colorado Medical Center, Denver). Proc. Natl. Acad. Sci. U. S., 47: 1181-91(Aug. 1961).

The life cycle of hyperploid S3 HeLa cells, irradiated with sublethal doses of x rays, was studied. A reversible mitotic lag was readily demonstrated at doses of 34 to 135 rads, produced by a block localized in the G2, pre-mitotic period. Visible chromosomal aberrations were produced in a majority of the cell population at these doses. It was proposed that this reversible mitotic lag, like irreversible reproductive death, is due to chromosomal damage, and that the reversible lag may reflect interference with chromosomal condensation just prior to and perhaps in the early parts of the mitosis. (auth)

27469 EFFECT OF α-PARTICLE AND X-RAY IRRADIATION ON DNA SYNTHESIS IN TISSUE CULTURES. C. L. Smith (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), B154: 557-70(Aug. 15, 1961).

The effects of both α-particle and x radiation on the DNA synthesis rate in mouse fibroblast and Hela cells in tissue culture are described. Tritiated thymidine autoradiography was used to indicate the rate of DNA synthesis in the single-layer cultures used. The results of these experiments show that the fraction of cells in a culture synthesizing DNA is not markedly affected by α-particles and x rays in the dose used in the experiment; the effect of either type of radiation is to reduce the rate of synthesis of DNA of the irradiated cells in synthesis; the effect of a given dose of either type of radiation is to reduce the rate of synthesis of all the cells to a constant fraction of what it was in the unirradiated cells; the rate of DNA synthesis is reduced to 37% (1/e) by a dose of ca. 25 α/μ^2 or an x-ray dose of 14,000 rads for mouse fibroblast cultures. In Hela cell cultures a dose of ca. 90,000 rads is needed to reduce the rate of DNA synthesis to 37% of the initial value; and the reduction in synthesis occurs not more than half an hour after irradiation and may be an immediate effect. The target shape can be roughly calculated from this data and if it is assumed to be cylindrical it appears to have dimensions 16 Å in one direction and 160,000 Å in the other, i.e., a long thin thread with a mol. wt. of ca. 5×10^7 in the case of the mouse fibroblast experiments. In the case of the Hela cell experiments the target volume gives a mol. wt. of ca. 10^7. These results are consistent with the view that the target may possibly by the DNA template or maybe DNP because of the high value for the molecular weight in one case. (auth)

27470 EFFECT OF IRRADIATION ON DNA SYNTHESIS ON CELLULAR BASIS (AN APPLICATION OF TRITIUM LABELED THYMIDINE AND RADIOAUTOGRAPHY). Akira Tsuya and Ikuo Hayano (Yokohama Univ. Hospital., Japan). Radioisotopes (Tokyo), 10: 122-34(Apr. 1961). (In Japanese)

Rats were exposed to 600 r of total-body irradiation, and the ability to synthesize DNA was studied in the erythroid and myeloid precursors over the 24 hours following exposure. Graphical and tabular data are presented; the erythroid precursors were much more radiosensitive than the myeloid precursors. (L.N.N.)

27471 EFFECT OF DOSE FRACTIONATION ON THE OCCURRENCE OF SKIN REACTIONS IN IRRADIATION WITH HIGH-ENERGY ELECTRONS. P. G. Paleani Vettori and O. Trucchi. Recentia med., 25: 9p.(Nov. 1960). (CNEN-79). (In Italian)

The effect of dose fractionation on the occurrence of skin reactions during treatment with fast electrons is studied by quantitative methods. Results are discussed and compared with those obtained using other radiations. (auth)

27472 A CASE OF RADIUM CANCER. H. Moriya and T. Takahashi (Tohoku Univ. School of Medicine, Sendai). Rinsho Hoshasen, 5: 54-7(1960).

A 65-year-old male with a cavernous hemangioma on the lower lip was treated with radium about 30 years ago and recovered. After that the patient developed an ulceration which turned into a cancroid at the same place. After radiation chronic dermatitis, ulcerating erosion, and malignant

degeneration developed. In the initial radium therapy the cancer showed some reaction and temporarily healed. After treatment the tumor developed again and resistance was seen. The tumor was removed surgically without effect. (Abstr. Japan Med., 1: No. 10, 1961)

27473 AGING IN IRRADIATED AND NONIRRADIATED HYDRAS. J. Ross Stevenson (Kent State Univ., Kent, Ohio) and Ralph Buchsbaum. Science, 134: 332-3(Aug. 4, 1961).

Evidence is presented that as hydras become older they bud more slowly and become more susceptible to adverse conditions. It was found that a 2000-roentgen dose of x radiation does not seem to affect the rate of these changes, and the mean number of tentacles does not change with age. (auth)

27474 VARIATION IN CLONES OF PENSTEMON GROWING IN NATURAL AREAS OF DIFFERING RADIOACTIVITY. William S. Osburn, Jr. (Univ. of Colorado, Boulder). Science, 134: 342-3(Aug. 4, 1961).

A study was conducted to determine whether the relatively high radioactivity of a natural area produces detectable morphological effects on plants of the species Penstemon virens, a plant of rather plastic morphology. While no differences in kinds of anomalies were found to exist between plants growing in the sites of highest and lowest radioactivity, the number of anomalies was greater in plants from sites of greatest radioactivity. (auth)

27475 BIOLOGICAL EFFECT OF BODY REACTION TO THE Co^{60} RADIATION. II. REACTION OF ANIMALS TO Co^{60} RADIATION. T. Takahashi (Tokyo Univ.). Tokyo Igaku Zasshi, 67: 1360-73(1959).

After radiation of normal rats with a lethal dose of Co^{60} γ rays either by whole-body single exposure or continued exposures, non-protein nitrogen (NPN) and urea nitrogen showed a slight change on the 1st day after radiation, but none thereafter. In the tumor-bearing rats, non-protein nitrogen and urea nitrogen were increased. After the radiation of tumor-bearing rats (lethal dose, whole-body exposure) the effect on the tumor was marked and the whole body effect was great; dysfunction of the kidney was observed. Changes in NPN and urea nitrogen were also seen. After radiation of the tumor, the effect was marked and life prolongation was noted. Large-dose radiation was lethal due to whole-body influence and kidney disturbance. Therefore, the changes in NPN and urea nitrogen were marked. After radiation of rhodamine B sarcoma, reduction of size, decrease in tumor weight, and, histologically, loose distribution of tumor cells, swelling and shrinkage of the nucleoli, and melting of the protoplasm were seen. After radiation to normal and tumor-bearing rats, histological changes in the kidney such as swelling, atrophy of the glomeruli, swelling of the canaliculi, and infiltration in Bowman's capsule were noted. (Abstr. Japan Med., 1: No. 10, 1961)

27476 WOUND PROCESS IN THE EYES OF GUINEA PIGS IRRADIATED WITH MODERATE X-RAY DOSES. V. T. Paramei. Vestnik Oftalmol., 73: No. 1, 36-8(1960). (In Russian)

Observations were made of the healing of a puncture wound in the cornea-scleral region of 25 guinea pigs irradiated with 100 to 600 r. The results show a slowed healing process in exposed animals. The amount of microorganisms is considerably higher in the conjunctival cavity of injured and healthy irradiated eyes. (R.V.J.)

27477 STUDY OF WENGER'S AUTONOMIC BALANCE TEST AND ITS APPLICATION TO FUNCTIONAL X-IRRADIATION. T. Ogura (Kurume Univ. School of Medicine, [Japan]). Yonago Igaku Zasshi 11: 284-96(1960).

Wenger's function test was conducted on 81 healthy persons as well as 17 patients suffering from autonomic imbalance by means of irradiation of the diencephalon, the carotid body, and the spinal cord. Half of the persons irradiated on the diencephalon and the carotid body showed a tendency of vagotony directly after irradiation, but the vagotony disappeared 3 hours after irradiation. The group irradiated on the spinal cord developed mainly vagotony, but a few became sympathicotonic. The recovery took place as above. The changes of the autonomic imbalance caused by the functional irradiation were greatest in the case of the irradiation of the spinal cord, followed by irradiation of the carotid body and the diencephalon. For patients with imbalance, the change was greatest in the irradiation of the carotid body, followed by irradiation of the diencephalon and the spinal cord. The changes of the autonomic balance of patients was greater than those of healthy persons and became smaller after the functional irradiation. (Abstr. Japan Med., 1: No. 10, 1961)

27478 THE INFLUENCE OF OXYGEN ON THE FREQUENCY OF RADIATION-INDUCED CHROMOSOME ABERRATIONS IN OOCYTES OF DROSOPHILA MELANOGASTER. H. Wind and H. Traut (Kernforschungszentrum, Karlsruhe, Ger.). Z. Vererbungslehere, 92: 34-7(1961). (KFK-50). (In German)

Abrahamson's results concerning the influence of oxygen on the frequency of x-ray induced structural changes (half-translocations) in Drosophila oocytes were generally reproduced, especially the demonstration of a "reverse" oxygen effect (under special experimental conditions protecting action of oxygen, sensitization by nitrogen). The added aberration frequencies of the 3rd and 4th day after the various treatments generally tended to decrease as compared with those of the first two days (dependence on state of maturity of the treated oocytes). Preirradiation treatment by nitrogen increased the aberration frequency significantly. Possible explanations of this effect are discussed. (auth)

27479 MECHANISMS IN RADIOBIOLOGY. Volume 1. General Principles. Maurice Errera and Arne Forssberg, eds. New York and London, Academic Press, 1961. 545p.

The physical and chemical aspects of radiation effects as well as biochemical changes produced in vivo and in vitro are discussed. Topics covered include physical principles of radiation action, target theory and radiation effects on biological molecules, radiation chemistry, the biochemical lesion in vivo and in vitro, cytological effects, effects on subcellular units and free-living cells, radiation genetics, and the induction of mutations as a method in plant breeding. (M.C.G.)

27480 STUDIES ON QUANTITATIVE RADIATION BIOLOGY. K. G. Zimmer. Translated by H. D. Griffith. New York, Hafner Publishing Co., Inc., 1961. 124p. Charge $2.75.

A study of radiobiology limited to physicochemical "primary" mechanisms and to the elementary biological entities or structures is presented. A short historical review is given. A generalized formal hit theory, the target theory, theories of action through diffusible agents, and recent developments in radiobiology are discussed. (M.C.G.)

27481 RADIATION BIOLOGY OF VICIA FABA IN RELATION TO THE GENERAL PROBLEM. John Read. Springfield, Illinois, Charles C Thomas, 1959. 293p. $10.50.

The actions of ionizing radiations on the root of the broad bean, Vicia faba are discussed. Topics covered include a

histological study of the growth of normal and irradiated roots, a statistical study of the growth of irradiated and control roots, the standard dose-response curve, mitosis and its inhibition by radiation, production of chromosome aberrations by radiations, factors which influence the rejoining of breaks, Revell's hypothesis regarding the origin of chromatid aberrations, the influence of dose rate and fractionation, effects of radiation on the synthesis of deoxyribonucleic acid and protein, the relation between the potency of an ionizing radiation and its mean linear energy transfer, the effect of dissolved oxygen on radiation sensitivity, the effects of cyanide and large gas pressures on radiation sensitivity, a comparison of the effects of x rays and 8-ethoxycaffeine, correlation of the variation in chromosome sensitivity during the cell cycle and the change in growth rate of treated roots, and a comparison of radiation effects in Vicia faba meristem cells with those cells of human, mammalian, and other tissues. (M.C.G.)

27482 LÉSIONS PROVOQUÉES PAR LES RADIATIONS IONISANTES. (Lesions Induced by Ionizing Radiations). A. Lacassagne, Ad. Dupont, P. Van Caneghem, J. Civatte, G. Mathé, Jean Bernard, J.-F. Duplan, M. Errera, J. Maisin, P. Maldagne, M. Lamy, J. Frézal, and Ch. Couygou. Paris, Masson & Cie, 1960. 208p.

A detailed survey is made of the anatomical pathological effects of ionizing radiations on the body. The topics discussed are a histological study of radiation effects on teguments, radiosensitivity of the normal cells of the blood and hemopoietic organs, experimental study on the radiosensitivity of fetal hemopoietic tissues of mice, radiation and growth of organisms and tissues, radiation as cancerization factors, genetic effects of radiations, and radiation effects on gametogenesis and the interstitial gland. (J.S.R.)

27483 PROBLEME UND ERGEBNISSE AUS BIOPHYSIK UND STRAHLENBIOLOGIE. II. BERICHT ÜBER DIE VIERTE ARBEITSTAGUNG BIOPHYSIK DER PHYSIKALISCHEN GESELLSCHAFT IN DER DEUTSCHEN DEMOKRATISCHEN REPUBLIK VOM 13-15 OKTOBER 1958 IN OBERHOF. (Problems and Results from Biophysics and Radiobiology. II. Report of the Fourth Biophysics Work Session of the Physical Society in the German Democratic Republic from 13 to 15 October 1958 in Oberhof). G. Pfenningsdorf and W. Eckart. Berlin, Akademie-Verlag, 1960. 248p.

A collection of 41 papers is presented, about half radiobiology and half biophysics. The following radiobiology topics are involved: the "hit" theory, measurement of radioactivity and radioisotope uptake, safety in radiation use, biological effectiveness, dose measurement and dose concepts. (T.R.H.)

Radiation Sickness

27484 (HW-69500(p.108-10)) PROTECTION AGAINST INTESTINAL RADIATION DAMAGE. M. F. Sullivan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The protective effect of cysteine was studied in rats under conditions of repeated x irradiation. Moderate protection was observed in total-body exposure experiments. When only the abdominal region was irradiated, the protective effect of cysteine was more pronounced, and total doses as high as 30,000 r were absorbed without gross evidence of acute damage to the intestinal tract. (auth)

27485 (HW-69500(p.114-19)) RADIATION PROTECTION TRIAL WITH ERIOGLAUCINE. H. E. Dziuk, D. R. Kalkwarf, and G. S. Vogt (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Erioglaucine was tested for radiation protection properties in beagle dogs exposed to whole-body radiation. Although survival was greater and circulating reticulocyte and neutrophil levels recovered in the treated animals, the results are not conclusive because of the small number of animals used. (auth)

27486 (HW-69500(p.120-4)) WATER CONSUMPTION AND ACUTE LETHALITY AFTER X IRRADIATION IN MICE CHRONICALLY ADMINISTERED P^{32}. L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The effect of oral administration to mice of 1.5 μc of P^{32} twice per week for 100 days was evaluated by testing their response to acute x ray doses of 700, 800, and 900 r. Following the acute challenge doses, the mortality in the pre-irradiated animals resembled that observed in the control animals, although the average body dose over the 100-day period approximated 70 rads and bone was exposed to over five times this dose. Water consumption was depressed during the first post-irradiation week and the degree of depression was related to the x-ray dose. A tenfold difference was observed between the organs of highest and lowest concentrations. At apparent equilibrium, the organ burdens in decreasing order of concentration were bone, thymus, liver, spleen, kidney, muscle, testes and brain. (auth)

27487 (HW-69500(p.125-30)) LEAKAGE OF MACROMOLECULES INTO THE RADIATION-DAMAGED INTESTINAL TRACT. M. F. Sullivan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The appearance of an I^{131}-labeled plasma protein substitute, polyvinylpyrrolidone (PVP), in the gastrointestinal tract was used to demonstrate increased capillary permeability following x irradiation or nitrogen mustard treatment of rats. The results of partial-body irradiation studies indicate that the observed effects on PVP excretion are caused by direct action on the intestinal epithelium. These effects were not caused by an increased excretion of PVP in the bile nor by an accumulation of secretions which are not reabsorbed because of impaired mucosal function. Treatment of x-irradiated animals with hesperidin-ascorbic acid or diisopropylfluorophosphate had no effect on PVP excretion, but prophylactic administration of cysteine did decrease leakage. (auth)

27488 (UR-595) LATE MANIFESTATIONS OF IONIZING RADIATION IN THE DOG. S. M. Michaelson, W. J. Quinlan, C. L. Hansen, Jr., R. L. Neidlinger, L. T. Odland, and J. W. Howland (Rochester, N. Y. Univ. Atomic Energy Project). May 31, 1961. Contract W-7401-eng-49. 16p.

Beagles of known age were bilaterally exposed to 1000 Kvp x rays to the whole-body or upper half of the body. One year after exposure, whole-body exposed animals appear clinically normal. Total leukocyte counts have returned to within 75% of the pre-exposure levels, with more rapid recovery among higher dose exposures. Clinical chemistries have remained within normal limits. Body weight is slightly increased in comparison with the controls. There is no evidence of cataract formation. No deaths have occurred in the 2 to 12 month period since irradiation. Upper body exposed animals show variable changes. Below 1500 r, weight is comparable to controls, total leukocyte counts are slightly below pre-exposure levels, and clinical chemistries have remained normal. There is no evidence of lenticular changes. General physi-

cal appearance is normal and no deaths have occurred between 2 and 12 months since irradiation. Survivors from 1500 and 1750 r groups show decreased weight. Total leukocyte counts have returned to pre-exposure levels. Residual corneal vascular opacification or posterior polar cataracts are evident in most of the 1500 and 1750 r survivors. In the 6 to 12 month period since irradiation, most of the 1500 and 1750 r survivors have developed pulmonary difficulty with dyspnea, oxygen desaturation, and terminal pulmonary fibrosis leading to death. (auth)

27489 (USNRDL-TR-519) INCREASED RADIORESISTANCE IN MICE INJECTED WITH URETHANE TWO DAYS BEFORE X-IRRADIATION. L. J. Cole and S. R. Gospe (Naval Radiological Defense Lab., San Francisco). July 10, 1961. 24p.

Adult female $(C57LxA)F_1$ mice received two intraperitoneal injections of an aqueous solution of urethane (1 mg/g body wt), one day apart. Twenty-four hours after the last injection, the mice were exposed to a single acute dose of 250 kvp x rays in the midlethal or lethal range. The 30-day LD_{50} for the urethane-treated mice was found to be 970 r; the LD_{100} was 1010 r. The corresponding values for the control irradiated mice were 790 r and 840 r, respectively. The radioprotective effect of urethane was not seen when the drug was administered 30 minutes before irradiation, nor when the mice were irradiated 7 days after the last urethane injection. The protective effect was not duplicated by pre-radiation exposure (1 or 2 days prior) to 100 r, 200 r, or 300 r. Non-irradiated mice given two daily injections of urethane as above exhibited a marked drop within 24 hours, in the total nucleated cell count of femoral marrow and peripheral blood accompanied by a definite increase in the myeloid/lymphoid cell ratio of the blood. The results suggest that urethane-induced alterations in cell population of bone marrow are accompanied by an increase in the number of relatively radioresistant cell types, involved in myelopoiesis. (auth)

27490 (USNRDL-TR-520) THE NON-SPECIFIC ACCEPTANCE OF SKIN TRANSPLANTS BY RADIATION CHIMERAS. M. S. Silverman (Naval Radiological Defense Lab., San Francisco). July 10, 1961. 22p.

The immunological status of lethally irradiated mice protected against the acute effects of radiation by the transfusion of rat or allelogenic, parental, or isogenic bone marrow was studied using the reaction against skin grafts as the indicator system. The data indicated that the radiation chimeras were immunologically unresponsive animals and were, therefore, able temporarily to accept skin grafts from donors foreign to both the irradiated host and the marrow donor. It was concluded that the ultimate rejection of the skin grafts was the result of the recovery of the host's immune response rather than the result of any contribution of donor marrow cells to the immune system. If the animal survives, a specific tolerance towards the bone marrow donor's skin may develop. A possible alternative hypothesis to explain the persistence of the foreign skin grafts despite deaths from secondary disease is discussed. (auth)

27491 (JPRS-864) ARMENIAN RUST-RESISTANT WHEAT VARIETIES AND PATHOGENESIS OF RADIATION INJURIES. Translated from Izvest. Akad. Nauk Armyan. S.S.R., Biol. Nauki, 13: No. 8; 35-58(Aug. 1960). 32p.

A translation of 2 articles in the Russian-language periodical Izvest. Akad. Nauk Armyan. S.S.R. Biol. Nauki is presented. The topics covered are the production of rust-resistant wheat varieties in Armenia and immunobiological shifts occurring during purulent-septic processes in animals suffering from radiation sickness. A separate abstract was prepared for one of the papers. (M.C.G.)

27492 (JPRS-8641(p.12-30)) IMMUNOBIOLOGICAL SHIFTS OCCURRING DURING PURULENT-SEPTIC PROCESSES IN ANIMALS SUFFERING FROM RADIATION SICKNESS. S. A. Akopyan, M. I. Balasanyan, K. A. Antonyan, S. A. Papoyan, S. G. Avetyan, E. A. Gasparyan, Zh. A. Pkhrikyan, and T. G. Arutyunyan. Translated from Izvest. Akad. Nauk Armyan. S.S.R., Biol. Nauki, 13: No. 8, 45-8 (Aug. 1960).

A study of immunobiological shifts occurring during local and general purulent-septic processes in animals suffering from accute radiation sickness was made on 13 puppies, 58 rabbits, and 11 dogs. In all tested animals, a study was made of the phagocytic activity of leucocytes. Radiation sickness was caused by a single general irradiation of the animals by means of x rays. It was established that the phagocytic activity of the leucocytes is sharply reduced both in percentage acting as phagocytes, as well as in regard to the intensity of bacterial absorption by individual leucocytes. (M.C.G.)

27493 STUDY OF THE RELATION OF RADIOPROTECTION OF CHELATING ACTIVITY "IN VIVO." L. Lombardi and R. Vertua (Università, Milan). Atti accad. med. lombarda, 16: 11-14(1961). (In Italian)

Compounds with good chelating activity for copper were tested for radioprotective properties (surviving time of x-irradiated mice, DNA concentration in the small intestine), and an important radioprotective activity was detected that was independent of its presence in the structure of SH groups. The relation between radioprotective and chelating activities is discussed in connection with the most recent theories on the mechanism of action of these drugs. (auth)

27494 THE PHARMACOLOGY OF KCN AS A PROPHYLACTIC AGAINST RADIATION. C. van der Meer and P. W. Valkenburg (National Defence Research Organization TNO, Rijswijk Z. H., Netherlands). Biochem. Pharmacol., 7: 237-47(Aug. 1961).

A dose of 100 μg of KCN protects about 80% of mice against a lethal dose of total body irradiation; on lowering the dose the protection decreases rapidly. A protective dose of KCN markedly reduces the oxygen tension in the spleen and bone marrow of these mice. The same dose reduces the total oxygen consumption of the animal to about 25%. The respiration is slowed considerably but the respiratory volume shows little change. The oxygen saturation of the arterial blood is unaltered, the saturation of the venous blood is increased. After an initial fall with about 50 mm Hg the blood pressure rises again but remains about 20 mm below normal. Concurrently with the hypoxia in the spleen and bone marrow, the oxygen tension in the brain is augmented considerably. It is concluded that KCN protects against radiation by causing hypoxia in the blood-forming organs. This hypoxia is probably caused by a severe local vasoconstriction due to intense vasomotor stimulation. (auth)

27495 A NEW CONCEPT OF RADIATION SICKNESS AS AN AUTOIMMUNE DISEASE. N. Allegretti (Univ. of Zagreb and Inst. Ruder Boskavic, Zagreb). Bull. sci., Conseil acad. RPF Yougoslavie, 5: 77(July 1960). (In English)

The effects of irradiation on the immune response in animals are reviewed. It is pointed out that ionizing radiation

induces mutation in somatic cells, and it is postulated that antibody producing cells can also undergo mutation and thus become foreign to the organism. The concept of radiation sickness as an autoimmune disease is discussed. (C.H.)

27496 PROTECTIVE ACTION OF CERTAIN INHIBITORS OF CHAIN OXIDATIVE PROCESSES IN ACUTE RADIATION SICKNESS. A. A. Gorodetskii, V. A. Baraboi, and V. P. Chernets'kii (Bogomolets Inst. of Physiology and Inst. of Organic Chemistry, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R., No. 6, 812-15 (1961). (In Ukrainian)

Propylgallate and other derivatives of gallic acid, administered 30 minutes before irradiation with a minimal absolute lethal dose (600 r), saved 43–50% of irradiated albino mice from death. A correlation is established between the anti-radiation effect of gallic acid esters, the length of the alcohol radical, and the solubility of the gallate. (auth)

27497 EFFECTS OF CHEMICALS ON RADIATION INJURY. I. A FUNDAMENTAL STUDY ON RADIATION INJURY. S. Hamada (Kagoshima Univ., [Japan]). Kagoshima Daigaku Igaku Zasshi, 11: 2041-5(1959).

Normal male and female mice were irradiated by a single whole-body exposure of 1000, 800, 700, 600, and 500 r, and the changes of the death rate, body weight, and general symptoms were noted. The greater the irradiation dose, the shorter was the life span of mice irradiated, according to a certain relationship. The body weight of irradiated mice appeared to decrease in proportion to the doses given. In the group of 500 r irradiation (half lethal dose), the weight was diminished rapidly at the 10th day and reached a minimum at the 15th day. Recovery was noted from the 20th day, and complete restoration was seen at the end of 1 month after exposure. General intoxication symptoms consisted of anorexia, inactivity of the erector muscles, mucous diarrhea, emaciation, and malaise. (Abstr. Japan Med., 1: No. 10, 1961).

27498 EFFECTS OF CHEMICALS ON RADIATION INJURY. II. EFFECTS OF INORGANIC SUBSTANCES ON RADIATION INJURY. S. Hamada (Kagoshima Univ., Japan). Kagoshima Daigaku Igaku Zasshi, 11: 2046-60(1959).

Some inorganic substances were administered prior to a single whole-body irradiation of 500 r. Animals were followed up until the 30th day after treatment. When inorganic sodium chloride, potassium chloride, calcium chloride, and magnesium sulfate were given, the death rate was decreased and toxic signs also were not severe. Administration of sodium phosphate inhibited the radiation effect and reduced the death rate. When disodium phosphate or sodium bicarbonate was administered, the protective effect was generally lower than that of neutral or acid salts. (Abstr. Japan Med., 1: No. 10, 1961)

27499 EFFECTS OF CHEMICALS ON RADIATION INJURY. III. EFFECT OF CENTRAL NERVOUS STIMULANTS, CENTRAL NERVOUS DEPRESSANTS PROTOPLASMIC POISONS, AUTONOMIC POISONS AND OTHER DRUGS ON RADIATION INJURY. S. Hamada (Kagoshima Univ., Japan). Kagoshima Daigaku Igaku Zasshi, 11: 2061-78(1959).

Administration (prior to x irradiation) of aminocordin, picrotoxin, strychnine nitrate, caffeine sodium benzoate, or philopon exaggerated radiation injury and shortened the life span. Barbital, chloral-hydrate, and morphine chloride appeared to inhibit radiation injury, while alcohol and urethan exaggerated radiation injury. Effects of ethylene tetrachloride, nitromin, mapharsol, and autonomic poisons were similar to those of central nervous stimulants. Procaine chloride, antipyrine, sulfadine, and streptomycin appeared to exaggerate radiation injury and decreased the survival rate. (Abstr. Japan Med., 1: No. 10, 1961)

27500 CONTRIBUTION TO THE PROPHYLAXIS AND THERAPY OF RADIATION SICKNESS. Dionigi Mereu and Cesario Pirastu (Università, Cagliari, Italy and Ospedale Civile, Cagliari, Italy). Minerva nucleare, 5: 63-8(Apr. 1961). (In Italian)

Considering the fact that leukopenia and changes in the blood serum are two of the main symptoms of radiation sickness, persons exposed to the effects of x rays were given anti-leukopenic, anti-anemic, and liver-protective treatment by administering high doses of vitamin B_{12} associated with folic acid, vitamin PP, and vitamin C. Favorable results were obtained. A response to treatment was observed in all cases. The effects of the drug were beneficial, not only as regards the white blood cell count, but also as regards the red blood cell count; as well as preventing the occurrence of a diminution in the red blood cell count during x radiation, it corrected pre-existing anemia. Less significant results were obtained as regards the serum protein fractions and colloidal tests, although positive results were observed in a fairly high proportion of cases. (auth)

27501 EXPERIMENTAL STUDIES ON RADIATION CATARACT. J. Horiuchi (Tokyo Medical and Dental Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2459-74(1960).

Young rabbits were x irradiated with 200 kvp. Dosage was measured in the orbits, and for registering the lens opacities, a new photographic method was devised. Mature cataracts were observed in all young rabbits radiated with over 1500 r within 12 weeks after radiation. With doses of less than 1000 r, mature cataracts never occurred, not even 56 weeks after radiation. The age of the animals was an important factor in relation to the onset of radiation cataract. After exposure to 2000 r, the younger the animals, the earlier the onset of lens opacities, and the more rapidly the progress of the cataractous process. Some degree of recovery was noted in lens injuries arising from exposure to x rays. Mature cataract formation should be inevitable when complete epilation around the eyelid is induced by x radiation. (Abstr. Japan Med., 1: No. 10, 1961)

CHEMISTRY

General and Miscellaneous

27502 (AFOSR-1035) THE DETERMINATION OF THE STRUCTURE OF ALPHA- AND BETA-FLUORONAPHTHALENES AND OTHER SELECTED MOLECULES BY INFRARED AND MICROWAVE TECHNIQUES. Final Report. Børge Bak (Copenhagen. Universitet). May 25, 1961. Contract AF 61(052)-73. 36p.

Analyses were attempted of alpha- and beta-fluoronaphthalene microwave spectra. Complete structures are given for thiophene and ethyl fluoride. Microwave analysis was made of 5 isotopic benzonitriles. Preparations of N^{15} and C^{13} enriched benzonitrile and C^{13} furans were carried out. Microwave analysis was made of alpha C^{13} enriched furan. Molecular structure correlations are discussed. (auth)

27503 (BMI-1530) THE COMPATIBILITY OF GAS COOLANTS AND CERAMIC MATERIALS IN COATED-PARTICLE NUCLEAR FUELS. Arthur Levy and John F. Foster (Battelle Memorial Inst., Columbus, Ohio). July 18 1961. Contract W-7405-eng-92. 31p.

The compatibility of CO_2, CO, steam, air, nitrogen, and hydrogen coolants with carbon, Al_2O_3, BeO, MgO, Nb_2O_5, SiC, UO_2, ZrC, and ZrO_2 ceramic materials was investigated to 1500°K. Thermodynamic compatibility was based on the loss of volatile species as calculated from available free-energy data and Knudsen evaporation rates. Available literature pertaining to kinetic (thermal and radiation) compatibility was reviewed and, where data were available, they were compared with the calculations. Tabulations of maximum operating temperatures for all the ceramic-coolant systems investigated were prepared as well as detailed tabulations of calculated erosion rates for each of the ceramics. Under conditions prescribed in the study Al_2O_3 and ZrO_2 are the ceramics most compatible with all coolants. Nitrogen is the gas coolant that appears to be most compatible with the widest variety of ceramic materials. (auth)

27504 (CF-60-5-34) HAZARDS AND EXPERIMENTAL PROCEDURE EVALUATION FOR STUDIES ON THE POLYMERIZATION AND HYDROLYSIS OF PLUTONIUM IN URANYL NITRATE AND NITRIC ACID SOLUTION AT ELEVATED TEMPERATURES. R. E. Biggers and D. A. Costanzo (Oak Ridge National Lab., Tenn.). May 9, 1960. 29p.

Because of the danger of precipitation of polymerized Pu^{4+}, a research program was initiated for studying the polymerization of Pu^{4+} in the $UO_2(NO_3)_2-HNO_3$ system. The present state of knowledge concerning the polymerization of Pu^{4+} is reviewed, and the program is discussed in detail, including equipment and procedures. The program is evaluated from the viewpoint of hazards, health physics procedures, and personnel safety. (D.L.C.)

27505 (DMIC-Memo-119) THE EMITTANCE OF IRON, NICKEL, AND COBALT AND THEIR ALLOYS. W. D. Wood, H. W. Deem, and C. F. Lucks (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 25, 1961. 84p.

A compilation was made of original test data on emittance and reflectance of Fe, Ni, Co, and their alloys. The data were taken from the literature published during the period from 1940 to 1959 inclusive, with some 1960 data. Graphs plotted using the data are presented. (M.C.G.)

27506 (GA-2068) REACTION-RATE STUDIES OF THORIUM–URANIUM DICARBIDES IN MOIST AIR. G. B. Engle (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Apr. 11, 1961. Contract AT(04-3)-314. 29p.

The reaction rates of ThC_2, ThC_2-UC_2, and UC_2 in moist air were measured and their reaction products analyzed. ThC_2 and ThC_2-UC_2 react rapidly with moist air, with complete conversion to oxide and gaseous products occurring in 1 to 3 hr; ThC_2 reacts ~10 times faster than UC_2. The carbide particles undergo large bulk-volume changes, and the reaction products consist of solid Th–U oxides, condensed hydrocarbons, gaseous aliphatic hydrocarbons, and H_2. Carbon-deficient materials have somewhat lower rates. The dicarbides are not reactive in N_2, but experienced a slight weight gain in dried air. (D.L.C.)

27507 (NBL-170) SEMIANNUAL PROGRESS REPORT [ON CHEMISTRY] FOR THE PERIOD JULY 1960 THROUGH DECEMBER 1960. (New Brunswick Lab., AEC, N. J.). Aug. 1961. 112p.

The investigation of several lots of plutonium sulfate tetrahydrate prepared up to 18 months ago to determine the suitability of the compound as a primary analytical standard for plutonium was concluded. Tests indicated that the compound is not appreciably affected by changes in relative humidity from 17 to 75%. No evidence of alpha radiolysis of the water of crystallization was found. Apparent increased resistance to heat up to 100°C was found to be a characteristic of large $Pu(SO_4)_2 \cdot 4H_2O$ crystals. The possible existence of another compound of plutonium(IV) sulfate was indicated upon heating the tetrahydrate at 153°C. A complete thermogram for $Pu(SO_4)_2 \cdot 4H_2O$ was run from 25 to 910°C; the temperature range for the formation of $Pu(SO_4)_2$ from the tetrahydrate was extended upwards from the previous 290 to 325°C limits to 370°C. Stable anhydrous $Pu(SO_4)_2$ produced at 325°C was found to be stoichiometric to within ±0.06% of the theoretical value; it was not hygroscopic below 50% relative humidity. Plutonium sulfate tetrahydrate appears to be satisfactory for use as a primary analytical standard of plutonium; the anhydrous salt, as an alternate standard. A quantitative spectrographic method was developed for the determination of trace impurities in high purity plutonium using a spectrograph modified, for safety considerations, for gloved box operations. Plutonium was separated from its impurities by adsorption on Dowex-1 anion exchange resin in 8N HNO_3 to minimize spectral interference and health hazards. The impurity-rich effluent was analyzed under conditions developed for maximum sensitivity by excitation in a D.C. arc using a gallium oxide matrix. Twelve elements were determined with an estimated over-all average deviation of ±15%. The lower limits of detection of the impurities compare favorably with those obtained from the carrier distillation method. Considerable data, including electrode types, matrix composition, excitation conditions, and optical tests results, were tabulated. The instrumentation and analytical technique for the detection of possible isotopic variation in the B^{11}/B^{10} ratio due to the chemical processing of boron compounds was developed and evaluated. A solid source, 12-inch radius mass spectrometer with a single rhenium filament was used. The procedure yields values of the B^{11}/B^{10} ratio with a standard deviation less than ±0.02 or 5% relative. Based upon the analysis of a synthetic standard, the accuracy of the ratio is 0.004 with a standard deviation of ±0.013. Significant dif-

ferences were found in the B^{11}/B^{10} ratios of boron metal and boric oxide derived from the same geological origin. The possibility of isotope fractionation during chemical processing is thus indicated. Other differences in the ratios found between other boron compounds could be caused by differences in geological origin. Interlaboratory data support the ratio values obtained. The four-component and the ratio methods, used at the New Brunswick Laboratory for uranium isotopic analyses, were analyzed for accuracy by analyzing a National Bureau of Standard s uranium isotopic standard NBS-U-930. The ratio technique was found to be superior in regard to precision, accuracy, and isotopic range. The ratio method gives a precise measurement on the U^{234}, U^{236} in the 1.0 to <0.1% range, relative to the U^{235}, U^{238}. The best estimate of accuracy is made by this method when primary interest is placed on the U^{235} value. The data indicate that a ratio method under controlled conditions gives more accurate and precise evaluation of an unknown compared to a synthetic, or a certified standard, than the up-scan and down-scan, four-component method. A method is described for the preparation of sodium tetraborate for mass spectrometer analysis from two different types of boron-containing compounds. Assays of enriched uranium oxide of known isotopic composition by the "NBL precise method," after heating at temperatures from 800 to 950°C, gave the theoretical uranium contents within less than 1 part per 10,000. Little variation of composition with heating temperature was detected. Oxide compositions intermediate between UO_2 and U_3O_8 were shown, as a result of thermogravimetric studies, to resemble solid solutions rather than intermediate compounds. A rapid method was developed for the assay of uranium in ore concentrates of high sulfate content. Data comparing gamma-ray spectrometry results with mass spectrometric values for samples of 79 to 93% U^{235} are presented, to further substantiate the reliability of the method. Boron present in graphite in the range 0.01 to 0.02% can be determined by a photometric method by measuring the absorption of the boron-quinalizarin complex. The sodium carbonate-treated graphite ash residue was dissolved in water. The boron-quinalizarin color was developed by the addition of quinalizaran in concentrated sulfuric acid and the light absorption was measured with a spectrophotometer. A method is described for determining enriched uranium in UO_2-stainless steel and $UO_2-Al_2O_3$ fuel element solutions using normal uranium synthetic reference solutions to determine the calibration curve. (auth)

27508 (NP-10585) STABLE BORON POLYMERS. Final Report. Charles E. Erickson and Edward G. Meloni (Rutgers Univ., New Brunswick, N. J. School of Chemistry). July 31, 1961. Contract Nonr-40414. 31p.

Activities in a program to prepare polymers containing the B-O-B linkage and having tetravalent B atoms are described. It is thought that such polymers may be resistant to oxygen and moisture. It was found that internal B-N bonds increase the kinetic stability of B compounds, however polymers with high enough molecular weights to be useful cannot be obtained. Stabilities are limited by a volatilization loss of amino groups. (J.R.D.)

27509 (NP-10594) RESEARCH ON THERMALLY STABLE INORGANIC AND SEMI-ORGANIC POLYMERS. Progress Report No. 1, Covering January 1, 1961 to June 15, 1961. E. C. Chapin, J. W. Dale, I. B. Johns, M. L. Nielsen, J. R. Van Wazer, and R. J. Wieeman (Monsanto Research Corp. Boston Labs., Everett, Mass.). June 30, 1961. Contract AF-33(616)-7853. 142p. (MRC-2015)

Activities in a program for discovery and development of new, useful inorganic or semi-organic polymers are discussed. Research is reported on phosphorus polymers, cyanofluorocarbons, superpressure studies, organophosphorus polymers and halide copolymers and polymers from difunctional phosphorus compounds and diamines. (J.R.D.)

27510 (ORO-400) SYNTHESIS AND FABRICATION OF REFRACTORY URANIUM COMPOUNDS. Summary Report [for] May 1959 through December 1960. K. M. Taylor and C. H. McMurtry (Carborundum Co. Research and Development Div., Niagara Falls, N. Y.). Feb. 1961. Contract AT-(40-1)-2558. 94p.

Activities are described in an investigation to develop refractory U materials for superior reactor fuels. Uranium carbide was prepared by cold pressing in pellets with densities of 92 to 96% of theoretical. Uranium nitride was synthesized, and it was found that dense specimens (95% of theoretical) could be obtained in N-deficient powder, however in stochiometric compositions the maximum density obtained was 85% of theoretical. In other work dense uranium silicide was prepared and several properties of UC, UN, and U_3Si_2 were studied. (J.R.D.)

27511 (TID-13422) SYNTHESIS OF ORGANOMETALLIC COMPOUNDS OF THE LANTHANIDE AND ACTINIDE SERIES. Second Quarterly Report, August 15, 1961. (Ethyl Corp., New York). Contract AT(11-1)-999. 12p.

Efforts to prepare CO containing derivatives of various lanthanide metals and Th are reported. Most of the carbonylation reactions studied were carried out using a reducing system. Various Grignard reagents as well as alkyl- and aryl-derivatives of the alkali metals and metallic Na, or combinations of these, were used, usually in an ether solvent, to facilitate reduction of the starting materials. Sodium benzophenone ketyl was also employed. The anhydrous trichlorides of several lanthanide metals, thorium tetrachloride and, in a few instances, isolated tris-cyclopentadienides were used in these reactions. It was found that the lanthanide metals, at least in their trivalent state, do not form complexes with either mono- or bidentate phosphines or N compounds which ordinarily form stable complexes with many d-transition metals, but prefer to complex with ligands containing an O donor atom. However, the desired enhancement of stability could not be achieved. None of the reactions were successful, although traces of iron carbonyl were formed when the reactions were conducted in an ordinary steel autoclave. An attempt to apply a synthetic method used for the synthesis of bis-π-arene compounds of d-transition metals such as Cr also met with failure. Future plans provide for more emphasis placed upon the study of uranium chemistry. (auth)

27512 (UCRL-9773) STUDY OF THE NEAR-ULTRAVIOLET SPECTRUM OF MAGNESIUM OXIDE (thesis). Sandor Trajmar (California. Univ., Berkeley. Lawrence Radiation Lab.). July 3, 1961. 60p.

The spectrum appearing in the region 3600 to 4000 A was produced in a King furnace and vacuum arc, and was studied under different pressures of hydrogen (or water), deuterium, and oxygen as well as at different magnesium oxide activities in order to identify the species present in the vapor phase over the oxide or in a magnesium arc at temperatures above 2000°C. From spectral intensity measurements it was concluded that species involving hydrogen (most probably MgOH) and at least one kind of oxide species contribute to the spectrum. Measurements of spectral intensity versus magnesium oxide activity showed that both the oxide and hydroxide contained one magnesium oxide. From isotope-shift studies it was concluded that there is

only one hydrogen atom involved in the hydroxide molecules. The hydroxide, deuteride, and oxide bands were separately produced and photographed at high resolution. The wave lengths of the hydroxide and deuteride band heads and of the rotational lines of the oxide bands in the region 3766 to 3820 A were measured for possible analysis. (auth)

27513 (HW-tr-26) INFLUENCE OF THE CRYSTAL DIMENSIONS ON THE OXIDATION KINETICS OF UO_2. B. Belbeoch, C. Piekarski, and P. Perio. Translated by Liz Appleby for Hanford Atomic Products Operation from J. Nuclear Materials, 3: 60-6(Jan. 1961). 16p.

The influence of crystal dimensions on the evolution of metastable phases during the oxidation reaction of UO_2 below 200°C was studied. Oxidation of UO_2 having a large surface area results in a progressive tetragonal deformation which terminates in a poorly crystallized γ oxide. Zones of coherent deformation were found, in agreement with the discontinuous diffusion model proposed by Perio. The existence of at least two tetragonal phases was confirmed. (D.L.C.)

27514 NOTE ON THE CRYSTAL STRUCTURE OF NIOBIUM DIOXIDE. Bengt-Olov Marinder (Univ. of Stockholm). Acta Chem. Scand., 15: 707-8(1961). (In English)

A NbO_2 crystal structure determination was made on the basis of complete Weissenberg data registered with CuK radiation. Single crystals of NbO_2 were obtained by melting a niobium and niobium pentoxide mixture in an electric furnace in an argon atmosphere. Fourier methods were applied in the determination and data were recorded. The structure is described. (L.N.N.)

27515 USES OF RADIOISOTOPES IN CHEMICAL RESEARCH. A. H. W. Aten, Jr. Arbeitsgemeinschaft Forsch. Landes Nordrhein-Westfalen, No. 78, 61-88. (In German)

The use of radioisotopes in chemical research is surveyed from von Hevesy to the present. (T.R.H.)

27516 A STUDY OF THE EFFECT OF CERTAIN ADDITIVES ON THE OXIDATION OF URANIUM IN ACID MEDIA. G. M. Nesmeyanova and G. M. Alkhazashvili. Atomnaya Energ., 10: 587-91(June 1961). (In Russian)

Amounts of 0.5% by weight of V_2O_5, CO_2O_3, $MnSO_4$, $CuSO_4$, $CoSO_4$, $FeSO_4$ and of minerals such as hematite, siderite and covellite were added as catalysts to test the dissolution of U_3O_8 and pitchblende by oxidants such as MnO_2, $KClO_3$ and HNO_3 in a sulfuric acid medium. The addition of divalent iron and copper to the leach solution results in complete dissolution of U_3O_8 by MnO_2 at a H_2SO_4 concentration of 10 g/l, while complete dissolution of U_3O_8 by $KClO_3$ takes place at a H_2SO_4 concentration of 50 g/l. Hematite had only a slight effect on the dissolution of U_3O_8 because of its poor solubility in mineral acids. Soluble salts of vanadium showed the greatest catalytic effect. Thus, U_3O_8 was completely dissolved at 90°C in one hour with the use of MnO_2 and $KClO_3$ as oxidants at a H_2SO_4 concentration of 10 g/l in the presence of vanadium. In oxidizing uranium with nitric acid in a sulfuric acid medium at a temperature of 20°C, the degree of extraction approaches 95%. The addition of elements with a variable valence in the form of readily soluble salts catalyzes the leaching of uranium from insoluble minerals. (TTT)

27517 INVESTIGATION OF THE PuO_2F_2–HF–H_2O SYSTEM (20°C DIAGRAM). I. F. Alenchikova, L. V. Lipis, and N. S. Nikolaev. Atomnaya Energ., 10: 592-6(June 1961). (In Russian)

The complex forming reactions, hydrolysis, and solubility in hydrofluoric acid solutions at various temperatures of plutonyl fluoride were studied by means of the isothermal solubility of the ternary system PuO_2F_2–HF–H_2O. Pure plutonyl fluoride and hydrofluoric acid were used as starting materials, equilibrating the mixtures in a Teflon container kept at 20 ± 1°C by a thermostat. The liquid phase was sampled by means of a small pipet after centrifugation of the mixture; the solid samples were taken from the sludge after decanting the supernatant liquid. The presence of three phases was established: plutonyl fluoride dihydrate $PuO_2F_2 \cdot H_2O$; tetrafluoro oxyplutonic acid $H_2PuO_2F_4 \cdot 4H_2O$ and plutonium oxyfluoride, PuO_2F_2. The chemical species were confirmed by electron absorption spectroscopy. The presence of the acid was established by a migration method and by potentiometric titration using a 0.119 solution of NaOH and glass electrodes. In the HF concentration range from 0 to 1.3%, $PuO_2F_2 \cdot 2H_2O$ is formed with a solubility increasing from 0.13 to 6.0% while a F/Pu ratio of 4 is maintained. The $PuO_2F_2 \cdot 2HF \cdot 4H_2O$ phase exists in the wide concentration range from 1.9 to 87.5% HF beyond which the solid phase becomes PuO_2F_2. (TTT)

27518 HEAT CONTENT AND FREE ENERGY OF THE REACTION: $HoCl_{3(s)} + H_2O_{(g)} \rightleftharpoons HoOCl_{(s)} + 2HCl_{(g)}$. Fritz Weigel and Hermann Haug (Universität, Munich). Chem. ber., 94: 1548-54(1961). (In German)

Using a Salvioni quartz-fiber balance, the equilibrium constant of the reaction $HoCl_{3(s)} + H_2O_{(g)} \rightleftharpoons HoOCl_{(s)} + 2\,HCl_{(g)}$ was measured in the temperature range 712 to 833°K. By combining the measured value with the ΔCp function for the vapor-phase hydrolysis of lanthanide trichlorides (ΔCp in kcal/°/mole $= -2.8 \times 10^{-3} - 3.6 \times 10^{-7}\,T + 44 \cdot T^{-2}$), the value was found for the change in free energy, ΔF^0_T (kcal/mole) $= 15.8 + 6.4 \times 10^{-3}\,T \cdot \log T + 1.8 \times 10^{-7}\,T^2 - 22 \times T^{-1} - 4.85 \times 10^{-2}\,T$, as well as for the enthalpy change, ΔH^0_T (kcal/mole) $= 15.8 - 2.8 \times 10^{-3}\,T - 1.8 \times 10^{-7}\,T^2 - 44\,T^{-1}$. From this the following thermodynamic constants result: $\Delta F^0_{298} = +6.0$ kcal/mole, $\Delta F^0_{785} = -7.7$ kcal/mole, $\Delta H_0 = 15.8$ kcal/mole, $\Delta H^0_{298} = 14.8$ kcal/mole, $\Delta H^0_{785} = 13.4$ kcal/mole, $\Delta S_{298} = 29.7$ cal/°/mole, $\Delta S_{785} = 26.7$ cal/°/mole. The heat of formation of HoOCl was $\Delta H^0_{298} = -231.6$ kcal/mole (as compared to a heat of formation of $\Delta H^0_{298} = 232.8$ kcal/mole for $HoCl_3$. (tr-auth)

27519 SOME OBSERVATIONS ON THE CRYSTALLIZATION OF BERYLLIUM OXIDE FROM A GASEOUS PHASE. P. P. Budnikov and N. V. Shishkov (Moscow Chemical-Technological Inst.). Doklady Akad. Nauk S.S.S.R., 138: 1093-4(June 11, 1961). (In Russian)

The growth of single crystals of refractory BeO at atmospheric pressure has been observed in argon at 1900, 1800 and even 1600°C. Compacted beryllium oxide 99.9% pure is maintained in a hollow graphite block for 10 hours or more at constant temperature in a graphite resistance furnace. The crystals of BeO are grown on the inner surface of the cover which is at a temperature 10 to 50°C below the temperature of the sample. Dendritic growths or whiskers are noted at angles of 60, 90 or 100° with the primary crystal. In a number of cases the crystals are not transparent because of the presence of a film of carbon evaporated from the graphite vessel (the film is not Be_2C, since carbon and BeO react only above 1950°C). Single crystals of BeO are very strong and can undergo large elastic deformations without breaking (the strength of BeO whiskers is 150,000 kg/cm² on bending). This method of growing oxide crystals would be very satisfactory, if the rate of growth could be increased, and if the condensation process could be controlled better at high temperatures. (TTT)

27520 THE ADSORPTION OF HEXANE AND BENZENE VAPORS ON NON-RADIOACTIVE AND RADIOACTIVE

SAMPLES OF BARIUM SULPHATE. L. D. Belyakova, V. V. Gromov, A. V. Kiselev, and Vikt. I. Spitsyn (Inst. of Physical Chemistry and Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 138: 1139-42(June 11, 1961). (In Russian)

Four samples of $BaSO_4$ were prepared with specific activities of 0, 96, 101 and 85 mc of S^{35} per gram. The samples were degassed at 200°C. The specific surface of the samples varied from 4 to 8 m^2/g as determined by the adsorption of nitrogen and argon at low temperatures. It was found that the specific activity of the sample had hardly any effect on its ability to absorb hexane or benzene. However, at low saturations the absorption of hexane and benzene per unit surface increases with increasing radioactivity in the sample. Additional calcining at 400°C leads to a greater decrease in the absorption of hexane and benzene for the radioactive samples than for the non-radioactive sample. Thus, the absorption of hexane on a non-radioactive sample decreased by a factor of three on calcining at 400°C, while the adsorption decreased by a factor of seven on calcining a radioactive sample of $BaSO_4$ at 400°C. The surfaces of all the samples become more uniform on calcining at 400°C. (TTT)

27521 A STUDY OF THE URANIUM HIGHER OXIDES AND URANIUM PEROXIDE BY AN ISOTOPIC METHOD. A. I. Brodskii and I. F. Franchuk (Pisarzhevskii Inst. of Physical Chemistry, Ukrainian SSR). Doklady Akad. Nauk S.S.S.R., 138: 1345-8(June 21, 1961). (In Russian)

Tracer O^{18} was introduced into various positions of $UO_4 \cdot 2H_2O$ which was subjected to slow thermal decomposition at various temperatures up to 700°C, and analysis of the composition of the intermediate and final products. The compound $UO_4^{18} \cdot 2H_2O$ tagged with O^{18} in the peroxide position was obtained by precipitating an aqueous solution of $UO_2(NO_3)_2$ with heavy $H_2O_2^{18}$ at room temperature or at 90°C. The compound $UO_4 \cdot xH_2O^{18}$ was obtained by exchanging H_2O^{18} with freshly-precipitated $UO_4 \cdot xH_2O$. It was found that the oxygen evolved on heating $UO_4^{18} \cdot 2H_2O$ up to 195°C has the same composition as that of the initial $H_2O_2^{18}$ used to prepare the uranium peroxide. Peroxide oxygen is evolved on treating U_2O_7 with acidified water. On heating uranium peroxide to 195°C, 1.9 mols of water per mole of UO_4 are evolved, and this water contains only 13 to 24% of the O^{18} in the initial H_2O_2. There is a rapid exchange of oxygen between UO_3 and water. The light water vapor from $UO_4^{18} \cdot 2H_2O$ decomposes the $U_2O_7^{18}$ which is formed during the thermal decomposition, and then, oxygen exchanges rapidly with the UO_3^{18} which is obtained from $U_2O_7^{18}$ reaction. It is concluded that uranium tetroxide has a true peroxide structure, since no exchange could be detected between heavy-oxygen uranium peroxide in a solution of light H_2O_2 even after 500 hours contact time. The decomposition of U_2O_7 takes place between 195 and 400°C. At about 300°C the composition of the evolved oxygen changes markedly and remains constant on heating to higher temperatures. Thus, it is concluded that, in contrast to UO_3 and U_3O_8 which have an oxide structure, the compounds $UO_4 \cdot 2H_2O$ and U_2O_7 are true peroxy compounds which contain individual atoms of peroxy oxygen in the structure. (TTT)

27522 F^{19} NUCLEAR MAGNETIC RESONANCE IN POLYCRYSTALLINE MgF_2. S. K. Ghosh, J. Lahiri, and S. K. Sinha (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys., 35: 236-9(May 1961).

Fluorine (F^{19}) nuclear magnetic resonance line shape was recorded in polycrystalline MgF_2. The second moment of the recorded line-shape was compared with that computed from the known lattice structure of MgF_2 crystal as given by x-ray diffraction studies. The agreement is satisfactory. (auth)

27523 THE ISOTOPIC-EXCHANGE REACTIONS OF B_2H_6 WITH DT, HT AND HD. J. S. Rigden and W. S. Koski (Johns Hopkins Univ., Baltimore). J. Am. Chem. Soc., 83: 3037-40(July 20, 1961).

The isotope effects of the diborane–hydrogen exchange and in the pentaborane–diborane exchange reactions were studied using deuterium and tritium as tracers. In the former reaction an inverse isotope effect was observed, whereas in the latter a normal isotope effect was obtained. The effects are interpreted in terms of previously proposed mechanisms. (auth)

27524 PRIMARY AND SECONDARY DEUTERIUM ISOTOPE EFFECTS ON RATE OF MUTAROTATION OF FULLY DEUTERIATED GLUCOSE AND MANNOSE. Norman C. Li, Arlene Kaganove, Henry L. Crespi, and Joseph J. Katz (Argonne National Lab., Ill.). J. Am. Chem. Soc., 83: 3040-3(July 20, 1961).

The rates of mutarotation of glucose, fully deuteriated D-glucose, D-glucose-1-d, D-mannose, and fully deuteriated D-mannose in H_2O, D_2O, and H_2O-D_2O mixtures, and in the presence of 0 to 0.05 M perchloric acid, at 25°, were studied. The decrease in rate in D_2O represents a primary isotope effect in that O–H and O–D bonds are broken and reformed. The secondary isotope effect on mutarotation is a consequence of the presence of C–D rather than C–H bonds in the molecule and also results in a decrease in the rate of mutarotation. For fully deuteriated glucose, the secondary isotope effect amounts to about 17% in water and about 16% in D_2O in neutral solution. The secondary isotope effect is essentially the same as for D-glucose-1-d, and may be accounted for by the supposition that the principal effect on the rate of mutarotation is due to the replacement of D for H in the carbon-hydrogen bond at carbon atom 1. (auth)

27525 RHODIUM HEXAFLUORIDE. Cedric L. Chernick, Howard H. Claassen, and Bernard Weinstock (Argonne National Lab., Ill. and Ford Motor Co., Dearborn, Mich.). J. Am. Chem. Soc., 83: 3165-6(July 20, 1961).

Rhodium hexafluoride was prepared by burning the metal in a fluorine atmosphere in a liquid nitrogen cooled quartz reactor. Solid RhF_6, in bulk, is black in color, and the gap is a deep red brown. Chemical analyses on different samples indicate the formula RhF_6 (calculated: F, 52.6; Rh, 47.4. Found: F, 51.8 ± 2.4; Rh, 47.8 ± 0.4). The molecular weight was found to be 219 ± 4 compared with a formula weight of 216.9. Features of the infrared spectra and other properties are also given. (P.C.H.)

27526 ISOTOPE EFFECTS IN DEUTERIUM OXIDE SOLUTION. PART II. REACTION RATES IN ACID, ALKALINE AND NEUTRAL SOLUTION, INVOLVING ONLY SECONDARY SOLVENT EFFECTS. C. A. Bunton and V. J. Shiner, Jr. (Indiana Univ., Bloomington and University Coll., London). J. Am. Chem. Soc., 83: 3207-14 (Aug. 5, 1961).

The treatment previously used for estimating solvent deuterium oxide effects on acid–base equilibria is applied to kinetic secondary isotope effects on reactions which do not involve a primary deuterium isotope effect. Explanations are provided for the differing solvent isotope effects upon A-1 and A-2 reactions, for the greater nucleophilic power of OD^- over OH^-, and for solvent-isotope effects in solvolyses. The calculated isotope effects, necessarily based upon approximate models for reasonable transition state structures, generally bracket the observed isotope ef-

fects. However, when the mechanistic situation is complicated, unambiguous distinction of mechanism based upon isotope effects is not possible. (auth)

27527 ISOTOPE EFFECTS IN DEUTERIUM OXIDE SOLUTION: PART III. REACTIONS INVOLVING PRIMARY EFFECTS. C. A. Bunton and V. J. Shiner, Jr. (Indiana Univ., Bloomington and University Coll., London). J. Am. Chem. Soc., 83: 3214-20(Aug. 5, 1961).

The interpretation of secondary solvent deuterium oxide isotope effects in terms of hydrogen bonding interactions between solute and solvent molecules is applied to reactions which involve primary deuterium isotope effects attendant on rate limiting proton transfer. The wide variations in magnitude of primary isotope effects are rationalized and correlated with transition state structure, and the treatment is shown to give reasonable calculated values for the secondary isotope effects. (auth)

27528 ISOTOPE FRACTIONATION AT THE METHYL CARBON IN THE REACTIONS OF CYANIDE ION WITH METHYL CHLORIDE AND METHYL BROMIDE. K. R. Lynn and Peter E. Yankwich (Univ. of Illinois, Urbana). J. Am. Chem. Soc., 83: 3220-3(Aug. 5, 1961).

The C^{13} isotope effect for isotopy at the methyl carbon atom was measured in the cyanizations of methyl chloride and methyl bromide in water solution between 11.4 and 55.5°. In contrast with results previously reported for the iodide reaction, the chloride and bromide systems exhibit relatively large temperature dependence, indicative of the greater importance of bond rupture than bond forming in the reaction coördinate motion. Simple three particle models for the reaction seem incapable for reproducing the experimental values of both the temperature-dependent and temperature-independent factors in the isotopic rate constant ratios. Some improvement in calculation of the temperature-dependent factors is available in the consideration of the changes which occur upon activation in the configuration of the methyl hydrogens. The possibility of significantly different reaction coördinate motions in the three cases is considered but does not seem particularly fruitful. (auth)

27529 SPECIFIC INTERACTION BETWEEN Np(V) AND U(VI) IN AQUEOUS PERCHLORIC ACID MEDIA. J. C. Sullivan, J. C. Hindman, and A. J. Zielen (Argonne National Lab., Ill.). J. Am. Chem. Soc., 83: 3373-8(Aug. 20, 1961).

Spectrophotometric, potentiometric, and proton relaxation measurements provide evidence for a specific interaction between the oxygenated cations Np(V) and U(VI) in an aqueous acidic media. A value of $K = 0.690 \pm 0.013$ was calculated for the reaction $NpO_2^+ + UO_2^{++} = [NpO_2^+ \cdot UO_2^{++}]$ at 25° in perchlorate media, from the spectrophotometric and potentiometric measurements. The reaction was also studied spectrophotometrically in aqueous chloride media. The improved value of 1.13638 ± 0.00016 abs. v. was determined for the formal potential of the Np(V–VI) couple in 1M perchloric acid at 25°. (auth)

27530 THE IDENTIFICATION OF NEUTRAL RUTHENIUM(III) CHLORIDE COMPLEXES: EQUILIBRIA INVOLVING NEUTRAL AND CATIONIC SPECIES. Robert E. Connick and Dwight A. Fine (Univ. of California, Berkeley). J. Am. Chem. Soc., 83: 3414-16(Aug. 20, 1961).

Previous work on chloride complexes of ruthenium in the +3 oxidation state resulted in the separation and identification of the cationic species $RuCl^{++}$ and the two isomeric $RuCl_2^+$ species. Two neutral (uncharged) complexes were obtained in pure form in solution and characterized. The formulas of the species were determined by use of freezing-point lowering experiments to establish the number of metal atoms per species and direct analysis to establish the number of chloride ions bound to each metal atom. The species were both found to have the formula $RuCl_3$ and are presumed to be isomers. The species were separated by elution from ion-exchange columns. Values were obtained for equilibrium quotients involving these species and the cationic ruthenium(III) chloride complexes. (auth)

27531 THE β-DEUTERIUM ISOTOPE EFFECT IN E1 ELIMINATIONS. Marc S. Silver (Amherst Coll., Mass.). J. Am. Chem. Soc., 83: 3487-8(Aug. 20, 1961).

Isotope effects of α-deuteriomethyl groups were determined for E1-type elimination in the solvolysis of t-pentyl chloride in 75% aqueous acetic acid in the presence of potassium acetate or silver nitrate and in the deamination of t-pentylamine in acetic acid, at 57°. The k_H/k_D ratios are approximately 2.5, 3.1 and 1.5, respectively. The results are discussed briefly. (auth)

27532 ON THE FORMATION OF $UC_{1-x}O_x$. Shingo Namba, Shosuke Imoto, and Tadao Sano (Osaka Univ.). J. At. Energy Soc. Japan, 3: 457-61(June 1961). (In Japanese)

From thermodynamic studies, it was inferred that any stable ternary compound in the region $U-UC-UO_2$ will be in equilibrium with CO gas of $10^{-3} \sim 10^{-4}$ mm Hg at 1600°C. Mixed powder compacts of UO_2 and UC having a ratio of 0 ~ 3 to 1 as well as that of UO_2 and UC_2 of $\frac{1}{3} \sim 3$ to 1 (ratio of UO_2 to UC_2) were heated at 1600°C for 4 hr in vacuum of 10^{-4} mm Hg. The phases after the reaction were identified and quantitatively determined by x-ray diffractographic techniques, which showed that the amount of UO_2 was much decreased and that of a UC-like phase having a slightly smaller parameter than UC was increased. This latter phase was considered to be $UC_{1-x}O_x$, and the x was calculated from the ratios of UO_2 to $UC_{1-x}O_x$ before and after the reaction. The value of x was also determined by chemical analysis of carbon and nitrogen, which was nearly equal to the value of x from the x-ray analysis. The largest value of x was 0.83 and was obtained by the reaction of a compact of UO_2 and UC of 3 to 1 ratio. The lattice parameter of $UC_{1-x}O_x$ was measured to be 4.944 Å and its theoretical density was calculated to be 13.91. (auth)

27533 BROMIDE ALKOXIDES OF ZIRCONIUM. R. N. Kapoor and R. C. Mehrotra (Univ. of Gorakhpur, India). J. Less-Common Metals, 3: 188-93(June 1961). (In English)

The reaction of zirconium isopropoxide and acetyl bromide was studied, and the compounds $ZrBr(OPr^i)_3 \cdot Pr^iOH$, $ZrBr_2(OPr^i)_2 \cdot Pr^iOH$, and $ZrBr_4 \cdot 2Pr^iOAc$ were isolated. The first two are stable to heat, but the third decomposes on heating even under reduced pressure giving lower bromides. It is shown for comparison that zirconium tetrachloride reacts with butyl acetate in a similar manner. $ZrBr_4 \cdot 2Pr^iOAc$ was isolated by carrying out the reaction between $Zr(OPr^i)_4$ and AcBr under milder conditions and was found to react with isopropanol to give an equimolecular mixture of $ZrBr_2(OPr^i)_2$ and $ZrBr_3(OPr^i)$. The great ease with which these compounds exchange their radicals was demonstrated by the reaction between dibromide and tetraisopropoxide when the monobromide compound crystallizes out in quantitative yield. The mono and dibromide isopropoxide derivatives react with butanols or butyl acetates to give products in which the isopropoxy groups are replaced. A number of new normal and secondary butoxide derivatives were isolated, but side reactions occur in the case of tertiary butoxides. (auth)

27534 OXIDATION OF URANIUM ALLOYS IN CARBON DIOXIDE AND AIR. J. E. Antill and K. A. Peakall (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Less-Common Metals, 3: 239-46(June 1961). (In English)

Weight gain–time curves were obtained for alloys of uranium containing up to 7.3% silicon, 10% titanium, 5% vanadium, 10% zirconium, 15% molybdenum, 10% niobium, and 1% copper in carbon dioxide at 500–1000°C and in air at 500°C. Additions of titanium, molybdenum, niobium, and copper reduced the attack by carbon dioxide at 680–1000°C by factors up to 500. None of the elements was found to be markedly beneficial in carbon dioxide at 500°C and the silicon alloys had a high rate of attack in carbon dioxide at most temperatures. Additions of molybdenum, titanium, and niobium reduced the attack in air at 500°C by factors up to 200. (auth)

27535 OBTAINING ZrO_2 FROM ZIRCONIUM CONCENTRATES. Karol Akerman and Jacek Salawa (Inst. of Light and Rare Metals, Skawina, [Poland]). Przemysł Chem., 39: 292-5(1960).

The method of obtaining pure zirconium oxide from concentrates of zircon (mineral), containing about 10% of TiO_2, is described in detail. The concentrate was prepared from Baltic Sea beach sands. The composition was as follows: ZrO_2 46–44%, TiO_2 13–8%, SiO_2 37–35%, and FeO_3 2%, Al_2O_3 3%. 2 kg of caustic soda was placed in a nickel crucible with 6 l capacity and heated to 800°C in a gas oven. One kg of zirconium concentrate was added in small portions under constant stirring. Melting temperature was increased for 30 minutes to 900°C and then the semi-fluid mass was poured out into a nickel container and was cooled. The cold mass was crushed and lixiviated for 8 hours with 10 l of distilled water at boiling temperature and then filtered. The collected sediment was dissolved in 5 l of concentrated hydrochloric acid. The solution was heated up to boiling temperature and SiO_2 precipitated by addition of a few ml of 4% gelatine solution. The SiO_2 sediment was collected by filtering and was washed, dried, weighed and analyzed. The filtrate, 11.35 l, was evaporated to about 4 : 1; after cooling a white sediment of $ZrOCl_2$ precipitated by itself. This was again filtered, washed with cold 28% hydrochloric acid and dissolved in distilled water and diluted to 15 liters. From this solution zirconium hydroxide was precipitated with ammonia, filtered, dried, and heated to 1000°C. As a result, a snow-white zirconium oxide was obtained. The filtrate left over after the first separation of $ZrOCl_2$ was evaporated to about 1.5 l volume and after cooling it, some more of $ZrOCl_2$ was obtained. It was treated in exactly the same way as the first portion, but the resulting ZrO_2 powder was grayish white. Altogether, 219.5 g of grade I and 74.4 g of grade II ZrO_2 were obtained, a total of 293.9 g, or, 80.9% of ZrO_2 which was present in 1 kg of zirconium concentrate. Analyses and detailed balance sheet of zirconium and titanium oxides are given. Zirconium oxide obtained by the method described above was tried out as a material for high-grade refractories. Test blocks made of ZrO_2 mixed with water and 1.5% sulfite solution and molded under about 100 kg/cm^2 pressure, disintegrated entirely after being fired at 1600–1700°C. After more research the following stabilization method was worked out: grind a mixture of 95% ZrO_2 and 5% MgO_2 for 20 hours in a ball mill. Having it moistened to 7% with addition of 1.5% sulfite solution (of 28°Be concentration), the forms have to be shaped at a pressure of about 100 kg/cm^2 and at 1500–1600°C, but the temperature must be increased slowly at only about 100°/h. Properties of sample blocks prepared as described above are listed. It was concluded that: titanium oxy-chloride is easily dissolved in the presence of zirconium oxy-chloride; because of the difference in solubility of oxy-chlorides, zirconium oxide, practically free of titanium, can be obtained from concentrates containing about 10% of TiO_2; and by following the above method, good-quality zirconium oxide with good yield can be obtained. (OTS)

27536 FORMATION OF IONS IN MASS SPECTROMETERS BY ION-MOLECULE REACTIONS. J. H. Beynon, G. R. Lester, R. A. Saunders, and A. E. Williams (Imperial Chemical Industries Ltd., Manchester, Eng.). Trans. Faraday Soc., 57: 1259-74(Aug. 1961).

It was found that a wide range of organic compounds containing oxygen or nitrogen atoms produces prominent peaks at masses greater than those of the parent molecules, when introduced into a mass spectrometer. The heights of these peaks were examined as a function of sample pressure, and the number and energy of the bombarding-electrons. The most prominent peak formed by ion-molecule reaction in any spectrum is generally that at mass $(p + 1)$, where p represents the mass of the "parent" or molecular ion, and it was found that the ratio $(p + 1)/p$ reaches a maximum value at electron energies close to the ionization energy of the molecules being studied. In any group of isomers (such as the isomeric C_7 ketones) the ratio $(p + 1)/p$ was a minimum for the symmetrical isomer and increased with the degree of asymmetry. The mechanics of the collision process between an ion and a neutral molecule and the lifetime of the complex formed are discussed, restrictions on energy transfer due to symmetry are considered, and the effect of bond orbital character assessed. (auth)

27537 SALT EFFECTS ON THE RATE OF EXCHANGE OF THALLOUS AND THALLIC IONS IN WATER AND HEAVY WATER. PART 2. THE EFFECT OF CHLORIDE ON THE SOLVENT REACTION. S. Gilks, T. E. Rogers, and Gwyneth M. Waind (Univ. of London). Trans. Faraday Soc., 57: 1371-6(Aug. 1961).

The chloride inhibition and catalysis of the thallous-thallic electron-exchange reaction in concentrated perchlorate solutions was measured in water and in heavy water. In the range of chloride ion concentration in which this ion is a catalyst for the exchange reaction, there was no kinetic deuterium isotope effect. From spectroscopic observations it was concluded that chloride and bromide ions form inner-sphere co-ordination complexes with thallic ions, whereas the sulfate ion forms an outer-sphere complex. The inner-sphere complex $TlCl^{2+}$ does not undergo electron exchange with the thallous ion whereas the sulfate outer-sphere complex does so. The opposite kinetic effects of sulfate and of perchlorate ions are also discussed. It is suggested that polyvalent oxy-anions may function as proton acceptors in reactive ion-pairs. (auth)

27538 HYDROGEN REDUCTION OF LOW-SURFACE AREA URANIUM TRIOXIDE. Sheila A. Morrow, S. Graves, and L. Tomlinson (United Kingdom Atomic Energy Authority, Springfields, Lancs, Eng.). Trans. Faraday Soc., 57: 1400-9(Aug. 1961).

The kinetics of the hydrogen reduction of uranium trioxide of surface area below 1.2m^2/g were investigated. An increase in surface area and pore volume occurred during the reaction and an intermediate compound (composition, $UO_{2.6}$ to $UO_{2.7}$) was formed. The initial rate of reduction was found to be directly proportional to the surface area of the UO_3 and to (hydrogen partial pressure)$^{0.78}$. The shape of the rate curve obtained was dependent on the nature of the UO_3 and the apparent activation energy for the reaction varied between 25 and 32 kcal/mole. The observed kinetics

were best interpreted in terms of hydrogen chemisorption on the solid surface as the rate-controlling step. Hydration or the addition of sulfate ions to the trioxide greatly increased its surface area. (auth)

27539 NUCLEAR MAGNETIC RESONANCE AND ITS APPLICATIONS IN CHEMISTRY. Bohdan Stalinski (Polytechnic Inst. of Wrocław, Poland). Wiadomości Chem., 15: 295-312(1961). (In Polish)

The principles of the theory and experimental techniques of nuclear magnetic resonance absorption are presented. The applications to the resolving of some chemical problems are given for selected examples. (auth)

27540 COMPOUNDS AND COMPOSITIONS CONTAINING PLUTONIUM. Glenn T. Seaborg (to U. S. Atomic Energy Commission). U. S. Patent 3,000,695. Sept. 19, 1961.

Processes are described for oxidizing plutonium to the hexavalent state with bromate, permanganate, ceric ions, dichromate, or peroxydisulfate plus silver cations, and for reducing hexavalent plutonium with hydrogen peroxide, ferrous ions, sulfite ions, or sulfur dioxide with or without a complexing agent (fluoride, acetate, oxalate or sulfate). The solutions obtained by these processes are also claimed, as are various plutonium compositions, namely PuO_4; PuO_2; Pu_2O_7; $Pu_2O_8(NO_3)_2$; $Pu_2O_5(NO_3)_2$; $Pu(OH)_2(NO_3)_2$; $Pu(OH)_3(NO_3)_3$; $Pu(NO_3)_4 \cdot xH_2O$; $PuO_2(NO_3)_2 \cdot xH_2O$; $Pu(IO_3)_4$; $PuPO_4$; $Pu_3(PO_4)_4$; PuO_2SO_4; $Pu(SO_4)_2$; PuF_3; $PuCl_3$; $PuBr_3$; PuF_4.

Analytical Procedures

27541 (AE-56) A CHEMICAL EIGHT GROUP SEPARATION METHOD FOR ROUTINE USE IN GAMMA SPECTROMETRIC ANALYSIS. II. DETAILED ANALYTICAL SCHEMA. K. Samsahl (Aktiebolaget Atomenergi, Stockholm). 1961. 18p.

A detailed ion-exchange procedure for the separation of chemical elements in eight groups suitable for subsequent gamma spectrometric analysis is described. The separation time for inorganic samples is usually about 1½ hours and for organic samples at least 2 hours. One man can separate and count three samples per day. In comparative measurements of short-lived isotopes in biological material, 10 to 12 elements can be analyzed, thus making possible 30 to 35 determinations per day for one man. (auth)

27542 (DP-612) A MICRODETERMINATION OF URANIUM IN THORIUM. Robert F. Overman (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 1961. Contract AT(07-2)-1. 16p.

A method was developed for the separation and determination of as little as 2 ppm uranium in thorium. The precision of the method is 16% at 95% confidence limits. The uranium is extracted with pure TBP and determined fluorometrically. (auth)

27543 (NP-10421) DE BEPALING VAN BARIUM. (The Determination of Barium). (thesis). Jacob Agterdenbos (Amsterdam. Universiteit). 1958. 85p.

Some aspects of the determination of barium are discussed. A survey is given of the statistical methods used in the study. The colorimetric determination of small quantities of barium precipitated as the chromate is discussed. Small quantities of calcium and strontium do not interfere. The determination of barium as the sulfate is reviewed in the remainder of the study. The quantitative precipitation of the barium and the coprecipitation of iron are the principle subjects. A literature survey is given and some experiments on the particle size of barium sulfate are described. (J.S.R.)

27544 (TEES-2671-1) COMPUTER COUPLED AUTOMATIC ACTIVATION ANALYSIS. Annual Report. Lloyd E. Fite, Derek Gibbons, and Richard E. Wainerdi (Texas. Agricultural and Mechanical Coll., College Station. Engineering Experiment Station. Activation Analysis Research Lab.). May 1, 1961. Contract AT(40-1)-2671. 106p.

The continued investigation of automated activation analysis as a routine analytical tool is described. This investigation included the development and construction of an automatic gamma ray spectrometer with automatic sample handling and automatic data processing facilities. The preparation of samples in a suitable form for both activation and radioactivity measurements was investigated, together with the use of an accelerator-type neutron generator as an alternative to a reactor for activation purposes, in a computer coupled system. An alternative computer program, which allows more rapid computations in certain instances, was developed and tested. This program is capable of evaluating the analytical data from 10 samples in about one minute. Finally, further modifications and developments in computer coupled automatic activation analysis are discussed. (auth)

27545 (USNRDL-TR-522) RADIOCHEMICAL DETERMINATION OF SODIUM-24 AND SULFUR-35 IN SEAWATER. D. Love and D. Sam (Naval Radiological Defense Lab., San Francisco). July 10, 1961. 27p.

Rapid radiochemical procedures were developed for determining Na^{24} and S^{35} in seawater containing fission product radionuclides. Na^{24} was separated from other radionuclides by scavenging with lanthanum hydroxide. Two sodium chloride precipitations with hydrogen chloride gas followed. The disintegration rate was determined by measuring the area of the 1.368-Mev gamma photopeak. The working time required for a single analysis was ½ hr; the precision, ±1%; the chemical yield, about 70%; and the total effective decontamination factor from fission products, $>>10^5$. S^{35} in seawater was separated from other radionuclides by precipitating barium sulfate. This was followed by reducing the sulfate to hydrogen sulfide with hydrogen iodide and by subsequently oxidizing sulfide to sulfate in an alkaline peroxide solution. The resulting sulfate ion was precipitated as barium sulfate for chemical yield determination and counting. The working time required for a single analysis was less than 1 hr; the precision, ±5%; the chemical yield, 70 to 80%; and the decontamination factor from fission products, $>10^7$. Although the samples tested were salt solutions contaminated with fission products, as in the case of nuclear explosions in the ocean and in salt domes, these methods are applicable to many other types of samples containing fission products and induced activities. (auth)

27546 (AEC-tr-4475(p.83-90)) DETERMINATION OF BORON CONTENT IN ROCKS BY THE NEUTRON METHOD. V. K. Khristianov, G. I. Panov, and A. A. Chernova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 76-81(1958).

A method for quantitative determination of B in rock by neutron absorption is described. Results are compared with those obtained by chemical methods and presented graphically. (J.R.D.)

27547 (AEC-tr-4475(p.151-6)) PROCEDURE OF ACTIVATION ANALYSIS OF ROCKS UNDER BOREHOLE CONDITIONS. Yu. S. Shimelevich. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i

Stabil'. Isotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 132-6(1958).

Theory and procedure related to analysis of borehole rocks by the activation method are discussed. A formula for gamma radiation intensity calculation is presented, and examples of activation analyses are given. Uses of activation analyses are increasing and at the present are used in mineral searches and petroleum prospecting. (J.R.D.)

27548 (AEC-tr-4633) THE DETERMINATION OF THE CONCENTRATION OF BORON IN GASEOUS MIXTURES BY MEANS OF NEUTRON BEAMS. Ya. Chudars, I. Taure, I. Mednis, and O. Veveris. Translated from Latvijas PSR Zinatnu Akad. Vestis, No. 3(152), 57-64(1960). 14p.

Aspects of determining the concentration of B in gaseous mixtures by neutron irradiation was investigated. It was found that such concentrations can be determined by the reaction $B^{10}(n,\alpha)Li^{7}$. An ionizing chamber with supplementary electrodes can be used to record the alpha count from this reaction. (J.R.D.)

27549 RELATIVE DATA OF CHEMICAL EQUILIBRIA GOVERNING THE SEPARATION OF ZIRCONIUM FROM HAFNIUM. I. DETERMINATION OF EQUILIBRIUM CURVES. J. Hure, M. Rastoix and R. Saint-James (A.R.C.A., Gif-sur-Yvette, France). Anal. Chim. Acta, 25: 1-9(July 1961). (In French)

Factors influencing the extraction of macro amounts of zirconium by tributylphosphate and the separation of zirconium from hafnium are discussed. (auth)

27550 A PROCEDURE FOR THE DETERMINATION OF THE RARE EARTH ELEMENTS, LANTHANUM THROUGH LUTETIUM, IN CHONDRITIC, ACHONDRITIC AND IRON METEORITES BY NEUTRON-ACTIVATION ANALYSIS. A. W. Mosen, R. A. Schmitt, and J. Vasilevskis (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Anal. Chim. Acta, 25: 10-24(July 1961). (In English)

The abundances of the rare earths, lanthanum through lutetium, were determined in chondritic, achondritic, and iron meteorites by neutron-activation analysis. After exposure to a thermal-neutron flux of $2 \cdot 10^{12}$ neutrons/cm^2/sec for 2 hr, the chondritic or achondritic sample, with added rare earth carriers, is dissolved after sodium peroxide fusion. Iron specimens are dissolved in a hydrochloric acid medium. The rare earths are then separated as a group from the matrix and are individually separated by means of a Dowex 50 W-X_{12} cation resin column and elution with 1 M ammonium lactate. The method is sensitive to fractional parts per million of the individual rare earths. The abundance of scandium may also be determined in the same procedure. (auth)

27551 EDTA TITRATIONS WITH EXTRACTIVE END-POINTS. I. DETERMINATION OF COBALT. A. J. Cameron and N. A. Gibson (Univ. of Sydney). Anal. Chim. Acta, 25: 24-7(July 1961). (In English)

A method for the determination of cobalt by the addition of excess EDTA and back-titration with standard cobalt solution is recommended. The titration involves an extractive method of end-point detection, depending upon the appearance of the blue color of the ion-association pair $[Ph_3MeAs]_2[Co(SCN)_4]$ in chloroform. The method is therefore suitable for the estimation of cobalt in highly colored aqueous solutions. Average errors are expected to be less than 0.5%. (auth)

27552 A SOLVENT EXTRACTION METHOD FOR THE SEPARATION OF IODIDE. P. W. West and A. S. Lorica (Louisiana State Univ., Baton Rouge). Anal. Chim. Acta, 25: 28-33(July 1961). (In English)

Solvent extraction is proposed for the isolation of anions. Data obtained in the extraction of iodide using cadmium as complexing agent under the influence of such factors as pH, addition of excess cadmium ions, initial concentration of the cadmium iodide solution, and temperature are presented. (auth)

27553 CHROMATOGRAPHIC SEPARATION OF IONS IN PRESENCE OF OXALATE, TARTRATE AND CITRATE, USING AQUEOUS ETHANOL AS SOLVENT. [PART] II. Eric John Singh and Arun K. Dey (Univ. of Allahabad, India). Anal. Chim. Acta, 25: 57-8(July 1961). (In English)

The separation of Al, Cr(III), Fe(III), Zn, Mn(II), Ni, Co, Ba, Sr, Ca, Mg, Na, K, and NH_4 in ternary mixtures with or without the addition of complexing agents (oxalate, tartrate, and citrate) by filter paper strip chromatography was studied with aqueous ethanol as solvent. (auth)

27554 COLORIMETRIC MICRODETERMINATION OF BORON IN STEELS WITH AZOMETHINE-H AS REAGENT. R. Capelle. Anal. Chim. Acta, 25: 59-68(July 1961). (In French)

A method which is based on preliminary separation with ion-exchange resin and colorimetric determination by means of azomethine-H is described for the determination of soluble and insoluble boron in steels. (auth)

27555 THE SPECTROPHOTOMETRIC DETERMINATION OF STRONTIUM WITH MUREXIDE (AMMONIUM PURPURATE). D. S. Russell, J. B. Campbell, and S. S. Berman (National Research Council, Ottawa). Anal. Chim. Acta, 25: 81-4(July 1961). (In English)

A procedure for the spectrophotometric estimation of μg quantities of strontium with murexide is described. Conditions for the optimum stability of the coloured strontium complex were determined, the main feature being the addition of large quantities of ethylene glycol to the system. Since elements interfere, it is necessary to isolate the metal before the determination. (auth)

27556 SPECTROGRAPHIC DETERMINATION OF BORON IN NUCLEAR GRAPHITE. F. Gianni and F. Potenza (S.P.A.S. Donato Milanese, Milan). Anal. Chim. Acta, 25: 90-2(July 1961). (In English)

A spectrographic method is described for the determination of boron (0.2–1.0 ppm) in nuclear graphite and for the estimation of 0.1–0.2 ppm of boron. Neither boron-free graphite electrodes nor additional foreign substances as internal standard are required. Both the electrodes consist of sample powder, properly bakelite-processed. The standard deviation is 10%. (auth)

27557 RELATIVE DATA OF CHEMICAL EQUILIBRIA GOVERNING THE SEPARATION OF ZIRCONIUM FROM HAFNIUM. PARTS II AND III. J. Hure, M. Rastoix, and R. Saint-James (Centre d'Etudes Nucleaires, Saclay, France). Anal. Chim. Acta, 25: 118-28(Aug. 1961). (In French)

The chemical equilibria governing the separation of zirconium from hafnium are considered with particular reference to the solvent. The conditions of separation of a mixture of tributylphosphate, diluent, and zirconium were studied as well as the interaction of tributylphosphate and zirconium. The latter results in the formation of dibutylphosphate which has a strong complexing capacity for zirconium. (auth)

27558 A MODIFIED TRITIUM GAS COUNTING PROCEDURE. J. L. Garnett, W. K. Hannan, and S. W. Law

(Univ. of New South Wales, Sydney). Anal. Chim. Acta, 25: 170-5(Aug. 1961). (In English)

The Wilzbach one-step method for tritium analysis was re-investigated because of difficulty in obtaining satisfactory results with the available catalysts. The important factors governing the conversion of tritium from an organic compound to the gaseous phase were studied. Such factors include the use of zinc dust instead of zinc mesh for the reduction step, temperature of combustion, and the effect of variation in catalyst weight and sample size on conversion efficiency. (auth)

27559 THE ANALYSIS OF UNIRRADIATED "FISSIUM" ALLOY BY OPTICAL EMISSION SPECTROSCOPY. Joseph A. Goleb (Argonne National Lab., Ill.). Appl. Spectroscopy. 15: No. 3, 57-60(1961).

An optical emission spectrographic method was developed for the quantitative determination of molybdenum, ruthenium, rhodium, palladium, and zirconium in normal uranium metal in the range of 2.5, 2.0, 0.30, 0.20, and 2.5%, respectively. The precision of the spectrographic method for molybdenum is ±1.0%, ruthenium ±1.8%, rhodium ±1.7%, palladium ±2.1%, and zirconium ±2.2% of the amounts present. The comparison of spectrographic and chemical results on 24 "fissium" alloy samples for molybdenum, ruthenium, rhodium, palladium, and zirconium shows a standard relative deviation from the chemical results of ±3.9, ±4.3, ±7.2, ±6.6, and ±7.5%, respectively. These samples were chosen at random from ingots by using routine sampling procedures. (auth)

27560 RADIOMETRIC METHOD OF ASSAYING SOLUTIONS FOR URANIUM IN THE PRESENCE OF IONIUM. N. N. Shashkina. Atomnaya Energ., 10: 392-3(Apr. 1961). (In Russian)

Results of radiometric and chemical determinations of uranium in ionium (Th^{230}) containing solutions are tabulated, and the sensitivities of the methods were verified. (R.V.J.)

27561 THE EFFECT OF THE MATERIAL COMPOSITION OF URANIUM ORES ON THE SCINTILLATION GAMMA SPECTRUM. A. G. Grammakov, A. K. Ovchinnikov, Yu. P. Lyubavin, V. M. Ovchinnikov, and A. M. Sazonov. Atomnaya Energ., 10: 624-6(June 1961). (In Russian)

A 128-channel, differential gamma scintillation spectrometer with a 30 × 10 mm NaI(Tl) crystal was standardized by means of Hg^{203}, Cs^{137}, Zn^{65}, Co^{60}, Na^{24} and calibrated radium samples. In order to imitate natural conditions, the uranium ore was poured into steel cylinders and held for at least 30 days in order to obtain equilibrium between radium and its daughter radon. The gamma spectra show that the absorption of the soft gamma radiation increases with increasing atomic number Z. Curves normalized with respect to $Z_{eff} = 27$ show that 0.05 to 0.10 Mev radiation is absorbed by a factor of 1.5 to 2.0 less in minerals with $Z_{eff} = 15$ and 19 as compared with the absorption in a mineral with $Z_{eff} = 27$. The curves are the same for energies above 510 kev. The magnitude of Z_{eff} had less effect on the integral spectrum than it had on the differential spectrum. (TTT)

27562 DETERMINATION OF THE Ra, Th AND K CONTENT OF ROCKS FROM AN AIRCRAFT. N. D. Balyasnyi, L. I. Boltneva, A. V. Dmitriev, V. A. Ionov, and I. M. Nazarov. Atomnaya Energ., 10: 626-9(June 1961). (In Russian)

A 3-channel analyzer was used for determining the Ra, Th, and K content of rocks by means of gamma-spectrum measurements taken from an airplane. At the energy threshold value of 70 kv the integral sensitivity of the instrument was 350 counts/sec at 1 microcurie/hr. On the basis of 4 different flight paths, the least mean square error was found to be 25%. Good reproducibility was obtained in the concentration changes within individual flights. On the basis of radiochemical values, it was found that the Ra concentration determined from the plane was overestimated by 28% and the Th concentration was underestimated by 21%. The K values varied 1 to 2% for sedimentary rocks and about 2.5% for granite with respect to literature data, although no control tests were made on the ground. Sandy deposits, effusive rocks, shales and granite were included in the tests. (TTT)

27563 ANALYSIS OF REACTOR FUELS AND OF MATERIALS AT THE ANALYTICAL CHEMISTRY DIVISION OF THE POLISH ACADEMY OF SCIENCES' NUCLEAR RESEARCH INSTITUTE. J. Minczewski. Atomnaya Energ., 11: 46-55(July 1961). (In Russian)

The studies in the above-mentioned institute are devoted primarily to the analytical determination of the rarer elements and to the measurement of impurities in trace amounts. During the past 5 years several highly sensitive methods for U determination were developed. A sensitivity range of 10^{-3} to 10^{-10}% was obtained in U analysis of ores and residues; however, this method presents the inconvenience of necessitating the preparation of special standards for the different types of ores. A potentiometric titration method using Cr sulfate was found useful for U measurements in the presence of V, Cr and Fe in the sulfuric acid solutions of ores. An oxidation-reduction titration in non-aqueous medium made use of Cr acetate in dioxane as reducing agent. Volkov's method of titrating U phosphate with NH_4 vanadate in the presence of phenyl anthranilic acid was further refined. For determining trace impurities in U compounds, spectrographic and spectrophotometric methods were primarily developed; methods to determine 14 impurity elements in concentrations ranging from 0.1 to 10 microgram/gram with an average error up to 20% were developed. Similar methods were used for the analysis of B, Ga and In while ion exchange analysis was found useful for determining the rare earth elements in irradiated fuels. (66 references). (TTT)

27564 RADIOMETRIC ANALYSIS OF β-ACTIVE GASES BY MEANS OF A SPHERICAL IONIZATION CHAMBER. A. D. Turkin. Atomnaya Energ., 11: 60-1(July 1961). (In Russian)

Internally filled ionization chambers are used at present for measuring the concentration of β-active gases but the data obtained have only a qualitative significance because the correlation between the ionizing current and the activity of the gases in the chamber is not known. In order to study this question, a point source emitting β-radiation was used, placing it in spherical chambers with radii of 5, 10, 15, 20, and 25 cm, using Cu, Al, Pb and plexiglas as construction material for every radius. The wall thickness chosen was always larger than the maximum free path of the particles in the material. The sources used consisted of C^{14}, Co^{60}, Tl^{204}, Sr^{89}, Sr^{90}, and Y^{90} deposited on a 12 mm diameter Al disk in thicknesses ranging from 15 to 20 microgram/cm^2. The activity of each source was determined with an average error of ±2%. During the tests the current was measured with an error of ±1.5% as a function of the location of source which was moved from the center toward the wall. From the relationship of the ionization current and the coordinates of the source, the correlation between the current and the activity of the gas can be easily determined. Under certain conditions the ratio I/QV (I = saturation current, Q = concentration of gases, V = volume)

is independent from the energy, making it possible to determine the concentration of a complex isotopic material by a simple measurement. (TTT)

27565 DETERMINATION OF LANTHANUM, SAMARIUM AND EUROPIUM IN MANGANESE NODULES BY NEUTRON ACTIVATION. Toshi Kawashima, Masumi Osawa, Yoko Mochizuki, and Hiroshi Hamaguchi (Tokyo Univ. of Education). Bull. Chem. Soc. Japan, 34: 701-5 (1961). (In English)

A gamma spectrometric method was developed for simultaneous determination of microgram amounts of lanthanum, samarium, and europium without chemical separation of each other. The sample was irradiated for 2 to 3 days, 5 hr each day, at a flux of the order of 10^{11}n/cm^2/sec. The rare earth mixture purified by lanthanum fluoride cycles was used for γ-ray counting at a given pulse height peak. The activity of each component was evaluated by resolving the decay curves obtained, and the amount calculated by comparing the activity with that of each monitor. (P.C.H.)

27566 UTILIZATION OF γ SPECTROGRAPHY IN THE ANALYSIS OF TRACES BY ACTIVATION. Serge May (Centre d'Etudes Nucleaires, Saclay, France). Bull. soc. chim. France, No. 6, 1089-95(June 1961). (In French)

Activation analysis is an analytical technique based on the induction of radioactivity in stable isotopes of the element to be determined. It was announced for the first time in 1936 by Hevesy and Levi who determined Dy in impure Y. Seaborg and Livingood in 1938 utilized charged particles in activation analysis and showed the presence of Ga of the order of several ppm in very pure Fe. The extreme sensitivity of the detection by radioactivity permits the determination of trace elements. Of the first 96 elements approximately 1000 radioactive species have been established and the number of radionuclides being discovered increases rapidly. (tr-auth)

27567 DETERMINATION OF TITANIUM, NIOBIUM, AND TANTALUM IN CEMENTED CARBIDES. E. Lassner and R. Scharf (Metallwerk Plansee A.-G., Reutte, Tirol, Austria). Chemist Analyst, 50: 69-71(Sept. 1961).

Titanium, niobium, and tantalum were determined after separation from cobalt and tungsten, without separation from each other. The initial hydrous oxide precipitate was dissolved in dilute hydrofluoric acid and the three desired elements were re-precipitated by cupferron at pH 3.5. The cupferron precipitate was ignited and the oxide residue was weighed and then fused with potassium bisulfate and dissolved in dilute sulfuric acid with hydrogen peroxide present. Titanium and niobium were determined by successive aliquots of the resulting solution; tantalum was calculated by difference. Results are presented in tabular form. (L.N.N.)

27568 DETERMINATION OF CALCIUM IN STRONTIUM SALTS AND STRONTIUM IN CALCIUM-RICH MATERIALS. P. Povondra and Z. Sulcek (Central Geological Inst., Czechoslovak Academy of Sciences, Prague). Chemist-Analyst, 50: 79; 93-4(Sept. 1961).

By an ion exchange approach, trace amounts of calcium are determined in strontium salts and trace amounts of strontium in calcite, aragonite, and mineral waters. The technique is also applied to the purification of calcium and strontium salts. (L.N.N.)

27569 MASS-SPECTROMETRIC ANALYSIS OF TRACE OXYGEN IN CARBON DIOXIDE. G. Nief and M. Severin (Centre d-Etudes Nucleaires, Saclay, France). Colloq. Spectroscopicum Intern., VIII Lucerne, Sept.(1959), 255-8 (1960). (CEA-1941). (In French)

The mass spectrum of pure CO_2 contains a peak of weight 32 whose relationship to a peak at 44 varies greatly depending on the previous history of the source of ions and even during the course of an analysis. The fact that this peak is more or less proportional to the pressure and that its appearance potential is the same as that of oxygen leads us to suppose that it is produced from oxygen formed by dissociation of the carbon dioxide on the tungsten filament. A prior treatment of the ion source with acetylene reduces the ratio 32/44 to a value of about 15×10^{-5}. This same treatment also stabilizes the spectrometer's sensitivity to oxygen. Two lines of introduction enable pure carbon dioxide, the specimen to be estimated and a reference mixture of known oxygen content, to be sent into the mass spectrometer in quick succession. Oxygen in the carbon dioxide in amounts ranging between 0 and 500 ppm can thus be determined to an accuracy of ±5 ppm, the analysis taking 30 minutes. (auth)

27570 THE GAMMA-RAY SPECTROMETRY OF FISSION PRODUCTS. V. GAMMA-RAY SPECTROMETRIC ANALYSIS OF FALLOUT SAMPLES. Ichiro Hattori (Ishikawajima-Harima Heavy Ind. Co., Ltd., [Japan]). J. At. Energy Soc. Japan, 3: 401-9(June 1961). (In Japanese)

The gamma spectrometric method for the analysis of fission products was applied to some fall-out samples. They included snow, dust in the open air, and ashes of plants. Comparison was made between the apparent ages of samples from the experimental γ-ray spectra with those from the β decay curves of the same samples. The agreement was good in one case, but not in the other. The cause of this disagreement was found in the predominance of Peak VI in the γ-ray spectrum of the latter sample. The data on the plant samples were obtained from other references. The present method was applied, and some nuclides were identified in the sample. Good agreement was found between both values of analyzing $Zr^{95} + Nb^{95}$, one of which was obtained from the normal method of γ-ray spectrometric analysis, and the other from the present method. Some attempts were also made to estimate the errors inherent in the method of the present type: misjudgement of age; mixing of different age fission products; products due to other types of fissions; and depletion of some components in fission products mixtures. It was concluded that the absolute errors of analysis of individual fission products were less than 50% in most cases. (auth)

27571 GRAVIMETRIC DETERMINATION OF CERIUM-(IV) AND ITS SEPARATION FROM RARE EARTHS USING 3-ACETYL-4-HYDROXYCOUMARIN. A. N. Bhat and B. D. Jain (Univ. of Delhi). J. Less-Common Metals, 3: 259-61 (June 1961). (In English)

3-Acetyl-4-hydroxycoumarin was used for the gravimetric determination of cerium(IV) between pH 4.0 and 8.5. Since the reagent does not form any complexes with other trivalent rare earths, estimations of ceric salts can be readily carried out even when these are present in large quantities. (auth)

27572 PHYSICS AND TECHNIQUE OF MASS SPECTROSCOPIC ANALYSIS. PART III. Hans Voshage (Max-Planck-Institut für Chemie (Otto-Hahn-Institut), Mainz). Kerntechnik, 3: 374-9(Aug. 1961). (In German)

The satisfactory solution of the gauge technical problem depending decisively on the choice of a suitable ion source, its correct treatment, and an understanding of the physical processes occurring in the source, are discussed. The electron-impaction-source is used for the analysis with

direction-focussing mass spectrometers. It furnishes ions with good energy homogeneity. (auth)

27573 REPORT ON THE DETERMINATION OF THE WATER CONTENT OF LIVING TREES BY FAST NEUTRONS AND LOW-ENERGY GAMMA RAYS. W. Kühn (Isotopen-Studiengesellschaft e.V., Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik, 3: 382-5(Aug. 1961). (In German)

Results are described which were obtained during investigations for the development of a method for quickly determining the humidity in living trees. The tested measuring principles are deceleration of fast neutrons and scattering of low-energy gamma rays at the hydrogen atoms of the measured object. (auth)

27574 THE SPECTROPHOTOMETRIC DETERMINATION OF SMALL QUANTITIES OF COBALT IN PLAIN AND ALLOYED STEELS. A. E. Sherwood (English Electric Co., Ltd., Bradford, [Eng.]). Metallurgia, 64: No. 381, 47-50 (July 1961).

A new method was developed whereby cobalt contents down to 0.005% in plain and alloyed steels may be determined spectrophotometrically as the cobaltous chloride complex in strong hydrochloric acid after the removal of interfering elements by anion exchange and amyl acetate extraction. (auth)

27575 DISTRIBUTION OF ISOTOPIC NITROGEN IN NITROGEN GAS DURING DENITRIFICATION. R. D. Hauck and D. R. Bouldin (Tennessee Valley Authority, Wilson Dam, Ala.). Nature, 191: 871-2(Aug. 26, 1961).

Equations are presented which permit calculation of the mole-fraction of nitrogen gas evolved from soil into an atmosphere containing nitrogen even though the amount of nitrogen-15 in the source material changes as a result of mixture with other soil nitrogen. The equations also give a quantitative estimate of the relative contributions to the evolved gas by both the original source and by other nitrogen-containing material in soil from a consideration only of mass spectrometric data obtained from the atmosphere above the soil. (P.C.H.)

27576 A RADIOCHEMICAL TECHNIQUE FOR THE DETERMINATION OF SHORT-LIVED FISSION GASES. Charles W. Townley, James E. Howes, Jr., Gilbert E. Raines, Ward S. Diethorn, and Duane N. Sunderman (Battelle Memorial Inst., Columbus, Ohio). Nuclear Sci. and Eng., 10: 346-51(Aug. 1961).

A radiochemical technique is developed for the determination of the release rates of short-lived fission gases from fuel specimens during irradiation. Fission-product gases with half lives ranging from 1.7 sec to 3.9 min are employed. These are Kr^{89}, Xe^{137}, Xe^{140}, and Xe^{141}. The procedure involves the collection and analysis of the solid daughter products of these gases. The gases are swept through a long tube packed with stainless steel mesh, and the daughter products deposit on the mesh as they are formed. The mesh is analyzed radiochemically for the daughter species, Sr^{89}, Cs^{137}, Ba^{140}, and Ce^{141}. From the results of these analyses, the release rates of the parent fission gases may be calculated with a knowledge of the transit time of the gases through the trap and the transport time from the point of release to the trap entrance. (auth)

27577 TRITIUM BREMSSTRAHLUNG ABSORPTION DETERMINATION OF SULFUR IN HEAVY OIL. Shigemasa Enomoto (Government Industrial Research Inst., Nagoya, Japan), Masuzo Watanabe, Tomihiko Furuta, and Chizuo Mori. Radioisotopes (Tokyo), 10: 112-19(Apr. 1961). (In Japanese)

Tritium bremsstrahlung passing through a cell containing heavy oil was measured with a Geiger-Müller counter. The tritium source contained 6 curies in the form of gas adsorbed on an 8.0 mg/cm^2 layer of titanium vacuum-evaporated on to a copper disc, and the cell was made from polyvinylchloride with mylar windows 100 microns thick. The results were as follows: The effective energies of x rays passed through cells 6 and 11 mm thick were about 9 and 10 kev, respectively. The results agreed very well with those estimated by the theory of monochromatic x-ray absorption. The sensitivity was increased by increasing the pass length of the radiation in the sample, whereas the transmitted intensity was decreased. The optimum cell length seemed to be about 10 mm. Other contaminants in heavy oil have little effect on sulfur determination, and the experimental error was about ±0.05% for samples containing less than 4% sulfur. The accuracy compares favorably with the bomb-sulfur method. (auth)

27578 NATURAL TRITIUM MEASUREMENTS BY ETHANE COUNTING. A. E. Bainbridge, Paula Sandoval, and H. E. Suess (Univ. of California, La Jolla). Science, 134: 552-3(Aug. 25, 1961).

A method is described for the synthesis of ethane from hydrogen that is at present used for the counting of low-level tritium activity. The reaction procedure is simple and involves the mixing of the hydrogen with acetylene over a colloidal palladium catalyst. Counting characteristics of ethane are found to be ideal. With a 1-liter counter filled to three atmospheres of ethane, only a tenfold tritium enrichment is necessary in order to obtain a sensitivity of 0.32 counts per minute per tritium unit. (auth)

27579 CHEMICAL ANALYSIS OF SURFACES BY USE OF LARGE-ANGLE SCATTERING OF HEAVY CHARGED PARTICLES. Anthony Turkevich (Univ. of Chicago). Science, 134: 672-4(Sept. 8, 1961).

The Rutherford scattering of charged particles from the heavier elements and nuclear scattering and (α,p) reactions from the light elements result in energy spectra that are characteristic of the nucleus being bombarded. A simple apparatus for analyzing surfaces based on these ideas can be made by using an alpha source such as Cm^{244}, a solid state detector, and an electronic pulse height analyzer. (auth)

27580 DETERMINATION OF RADIOPHOSPHORUS BY SOLVENT-EXTRACTION. Harley H. Ross and Richard B. Hahn (Wayne State Univ., Detroit). Talanta, 8: 575-8(Aug. 1961). (In English)

A procedure is given for the determination of radiophosphorus in the presence of other activities. Potassium phosphate is added as carrier and the phosphorus is extracted as phosphomolybdic acid into a butanol-chloroform mixture. The activity is back-extracted into ammonium hydroxide and the phosphate is precipitated as magnesium ammonium phosphate. This may be air-dried or ignited to magnesium pyrophosphate for counting. The method is rapid, accurate, and free from interference by other radionuclides. Especially noteworthy is the excellent separation from radioarsenic. (auth)

27581 A NEW METHOD FOR THE SPECTROPHOTOMETRIC DETERMINATION OF MICROGRAM QUANTITIES OF TITANIUM. J. Korkisch (Universität, Vienna). Talanta, 8: 583-7(Aug. 1961). (In German)

A very sensitive and accurate method for the spectrophotometric determination of microgram quantities of titanium was developed. Solochrome Black AS in a hydrochloric acid-methanol medium is used as the reagent. This dyestuff reacts with titanium forming a red-violet colored

complex, which shows maximum absorption at 390 mμ. By means of this method as little as 0.1 ppm of titanium can be determined with satisfactory accuracy. The interferences of iron[3], copper[2], zirconium, and hafnium can be eliminated by the addition of ascorbic acid and EDTA. (auth)

27582 THE DETERMINATION OF TRACES OF PALLADIUM IN SAMPLES OF PLATINUM BY NEUTRON-ACTIVATION ANALYSIS. R. A. Killick and D. F. C. Morris (Brunel Coll. of Tech., London). Talanta, 8: 601-4(Aug. 1961). (In English)

In order to avoid self-shielding differences between samples and standards during neutron-irradiation, standards were prepared by the addition of very small known amounts of palladium to analytical samples. Each determination required 0.1 g of sample, and a radiochemical procedure using carriers was employed to isolate the induced palladium activity. (auth)

27583 THE DETERMINATION OF RHENIUM IN ROCKS BY NEUTRON-ACTIVATION ANALYSIS. D. F. C. Morris and F. W. Fifield (Brunel Coll. of Tech., London). Talanta, 8: 612-18(Aug. 1961). (In English)

Samples of the powdered rocks together with standards were irradiated. Rhenium was separated from the irradiated rocks by a radiochemical procedure, using carriers, precipitations, and solvent extractions. Radiochemically pure Re^{186} was counted, and the chemical yield determined gravimetrically. Results for the rhenium contents of the standard rock samples Gl and Wl are reported. The ultimate sensitivity of the analytical method is ca. 5×10^{-5} ppm Re. (auth)

27584 THE USE OF RUTHENIUM TETROXIDE AS A CATALYST IN REDOX TITRATIONS. C. J. Keattch (International Nickel Co. (Mond) Ltd., London). Talanta, 8: 620-3(Aug. 1961). (In English)

In the titration of arsenious oxide with ceric sulfate, ruthenium tetroxide can be used as a catalyst only if a potentiometric end-point is employed. On the other hand, in the oxidimetric determination of sulfite with ferricyanide, a potentiometric end-point is obligatory and the reaction is catalyzed equally well by ruthenium or osmium tetroxide. The former is preferred because of its relative nontoxicity and lower cost. (auth)

27585 DETERMINATION OF CESIUM IN ROCKS BY THE FLAME SPECTROPHOTOMETRIC METHOD. V. I. Lebedev (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim., 16: 272-4(May-June 1961). (In Russian)

A method is described for determining Cs in rocks. A preliminary chemical concentration separates the elements of the third and the second groups. With instruments of resolving power, it is recommended that the flame background be measured at three points using the solution free from Cs. (tr-auth)

27586 INVESTIGATIONS IN THE ANALYTICAL CHEMISTRY OF THALLIUM. COMMUNICATION 6 ON NEW COMPLEXOMETRIC METHODS FOR DETERMINING THALLIUM. A. I. Busev and V. G. Tiptsova (Moscow State Univ.). Zhur. Anal. Khim., 16: 275-8(May-June 1961). (In Russian)

A method was developed for the indirect complexometric determination of thallium at pH 2. The possibility is shown of the successive complexometric titration of iron (III) and thallium (III), bismuth and thallium. It was established that thallium (III) iodide complexes stoichiometrically react with complexone III at pH 6 to 8, and a complexometric method was worked out on this basis for the determination of thallium with a starch-iodide indicator. (tr-auth)

27587 QUANTITATIVE DETERMINATION OF SCANDIUM BY MEANS OF HALOGEN-SUBSTITUTED MANDELIC ACID. I. P. Alimarin and Han-hsi Shen (Moscow State Univ.). Zhur. Anal. Khim., 16: 279-83(May-June 1961). (In Russian)

The precipitation of scandium with p-halogen-mandelic acids was studied. The composition of the precipitates corresponds to the formula $H_3[Sc(Gal \cdot C_8H_5O_3)_3] \cdot H_2O$ where Gal = Cl, Br, I. Methods were developed for determining and separating scandium from cerium rare earths by means of p-halogen-mandelic acids. The extraction of scandium p-bromo- and p-chloromandelates with organic immiscible solvents was investigated. It is shown that scandium can be separated from the cerium rare earths by extraction with isoamyl alcohol. (tr-auth)

27588 2-(4-CHLOR-2-PHOSPHONBENZENEAZO)-1,8-DIHYDROXYNAPHTHALENE-3,6-DISULPHONIC ACID (CHLOROPHOSPHONAZO I)—AS A REAGENT FOR THE PHOTOMETRIC DETERMINATION OF URANIUM(VI). A. A. Nemodruk, Yu. P. Novikov, A. M. Lukin, and I. D. Kalinina (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow and All-Union Scientific-Research Inst. of Chemical Reagents, Moscow). Zhur. Anal. Khim., 16: 292-6(May-June 1961). (In Russian)

It is shown that 2-(4-chlor-2-phosphonbenzeneazo)-1,8-dihydroxynaphthalene-3,6-disulphonic acid (chlorophosphonazo I,) may be used for the photometric determination of uranium(VI) and has properties similar to those of 2-(2-arsenobenzeneazo)-1,8-dihydroxynaphthalene-3,6-disulphonic acid (arsenazo). The main difference is that the chlorphosphonazo-uranium(VI) compound is more stable than the arsenazo-uranium(VI) compound, which permits the determination of uranium in more acid solutions. When uranium(VI) is determined with chlorphosphonazo, the interference of masking substances is considerably lower. A photometric method is suggested for the determination of uranium(VI) by means of chlorphosphonazo I after its separation from interfering elements by the extraction process. (tr-auth)

27589 SEPARATION OF URANIUM AS AMMONIUM URANYL PHOSPHATE AND ITS GRAVIMETRIC DETERMINATION BY IGNITION TO $U_2O_3P_2O_7$. A. E. Klygin, D. M. Zavrazhnova, and N. A. Nikolskaya. Zhur. Anal. Khim., 16: 297-302(May-June 1961). (In Russian)

The solubility product of ammonium uranyl phosphate $NH_4UO_2PO_4 \cdot 3H_2O$ has been determined to be $(3.6 \pm 0.4) \times 10^{-26}$ at 25°. A gravimetric method for the determination of uranium was developed including the precipitation of ammonium uranyl phosphate in the presence of ammonium ethylenediaminetatraacetate and its weighing as $U_2O_3P_2O_7$. (auth)

27590 CONDITIONS FOR PHOTOMETRIC DETERMINATION OF FLUORINE WITH THE ARSENAZO REAGENT. A. F. Kuteinikov (All-Union Scientific-Research Inst. of Minerals, Moscow). Zhur. Anal. Khim., 16: 327-30(May-June 1961). (In Russian)

Colored complexes of the arsenazo reagent were used for determining fluorine. Compounds of aluminum, uranyl-ion, beryllium, thorium, and rare earths are the most suitable for this purpose. Conditions are established for the determination of fluorine by the decrease of the color intensity in a wide range of concentrations (from hundredths of microgram to tenths of milligram in 1 ml). (tr-auth)

27591 INCREASE OF THE SENSITIVITY OF THE POLAROGRAPHIC DETERMINATION OF URANIUM IN THE PRESENCE OF VANADIUM AND PHOSPHATE IONS. V. G. Sochevanov, N. V. Shmakova, L. T. Martynova, and G. A. Volkova. Zhur. Anal. Khim., 16: 362-3(May-June 1961). (In Russian)

It has been found that the polarographic wave of uranium, catalyzed with vanadium (IV), improves its form in the presence of phosphoric acid ions. (tr-auth)

27592 PHOTOMETRIC DETERMINATION OF CERIUM. A. I. Cherkesov and T. S. Zhigalkina (Saratov Pedagogical Inst., USSR and Astrakhan Technical Inst. of Fish Industry and Economy, [USSR]). Zhur. Anal. Khim., 16: 364-5 (May-June 1961). (In Russian)

A photometric method is suggested for determining small amounts of cerium by means of a sulfuric acid solution of methyl red. The method is based on the redox reaction of the azo dye with cerium (IV). The decrease of the absorbance value of the azo dye solution is a linear function of the quantity of added cerium. Moderate quantities of Cu^{2+}, Co^{+2}, Ni^{2+}, Zn^{2+}, Mn^{2+}, Mg^{2+}, Cd^{2+}, Cr^{3+}, Al^{3+}, Fe^{3+}, MoO_4^{2-}, UO_2^{2+}, Cl^-, and NO_3^- do not interfere with the determination. (tr-auth)

27593 DETERMINATION OF RHENIUM IN ALLOYS. D. I. Ryabchikov and A. I. Lazarev (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim., 16: 366-7(May-June 1961). (In Russian)

Small amounts of Re in alloys can be determined by the thiocyanate method after its preliminary separation by means of cationite. The method of the direct photometric determination of rhenium as thiourea complex is more rapid. (tr-auth)

27594 THE EFFECT OF SOME PARAMETERS ON THE FUNCTIONING OF THE IONIZATION DETECTOR FOR PROMETHEUS-147. G. A. Gaziev, S. N. Oziraner, M. I. Yanovskii, and V. S. Kornyakov (Inst. of Physical Chemistry, Academy of Sciences, USSR). Zhur. Fiz. Khim., 35: 1150-2 (May 1961). (In Russian)

The design of an ionization detector for the Pm^{147} gas chromatograph is described. The sensitivity threshold is 1×10^{-9} mol when operating under conditions of ionic saturation current, using air, nitrogen, or hydrogen as carrier gases. The sensitivity increases 5 to 7 fold when argon is used as carrier. With increase in voltage the sensitivity increases to 8×10^{-13} mol (at 2000 v and source energy is 10 mc). Such sensitivity may also be obtained from a 1 mc source with a slight increase in voltage (2200 v). (tr-auth)

27595 SPECTROPHOTOMETRIC INVESTIGATION OF Pu(IV) COMPLEXING WITH ARSENAZO. A. E. Klygin and V. K. Pavlova. Zhur. Neorg. Khim., 6: 1050-4(May 1961). (In Russian)

Spectrophotometric studies of $PuCl_4-H_6R-HCl-H_2O$ indicate the formation of $Pu(OH)H_4R^+$ or PuH_3R^+. At 20°C their light damping coefficients are $E_{590\,m\mu} = 2.20 \times 10^4$ and $E_{600\,m\mu} = 2.17 \times 10^4$; their complex formation constants are 3.6×10^6 and 4.8×10^7 with the maximum yield at pH 2.20. Spectrophotometric determination of Pu(IV) may be carried out in solutions of 10^{-4} mole of arsenazo and from 2 to 5 pH. (R.V.J.)

27596 GAS CHROMATOGRAPHY, 1960. Proceedings of the Third Symposium, held at Edinburgh 8-10 June 1960. R. P. W. Scott, ed. London, Butterworths, 1960. 480p.

Thirty-three papers are presented on the theory, principles, developments, techniques, applications, and equipment of gas chromatography. The major topic of these papers concerns the detectors used for the various applications and the techniques employed in the various fields of application. (N.W.R.)

General Inorganic and Physical Chemistry

27597 (NAA-SR-6003) THE CLOSEST PACKING OF SPHERES (A UNIFYING BASIS FOR CRYSTAL STRUCTURES). William G. Gehman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 30, 1961. Contract AT(11-1)-GEN-8. 75p.

An intuitive approach to the understanding of crystal structures is presented in terms of the concept of the closest packing of spheres. The qualitative features of the concept are sorted out and correlated by successively treating single, double, triple, and multiple layered arrays of closest packed spheres. The importance of the interstice lattices is emphasized. A translation-permutation algebra is developed for the purpose of quantitatively stating the qualitative features of closest packing. (auth)

27598 (NASA-TR-R-112) A METHOD FOR THE CALCULATION OF LATTICE ENERGIES OF COMPLEX CRYSTALS WITH APPLICATION TO THE OXIDES OF MOLYBDENUM. William S. Chaney (National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.). 1961. 99p.

A theoretical study was made of molybdenum dioxide and molybdenum trioxide in order to extend the knowledge of factors involved in the oxidation of molybdenum. New methods were developed for calculating the lattice energies based on electrostatic valence theory, and the coulombic, polarization, Van der Waals, and repulsion energies were calculated. The crystal structure was examined and structure details were correlated with lattice energy. (auth)

27599 (NP-10427) HET SPECTRUM VAN IRIDIUM STRUCTUUR, ZEEMAN-EFFECT EN CONFIGURATIE-BEREKENINGEN. (The Iridium Spectrum. Structure, Zeeman-Effect and Configuration Calculations). (Thesis) Theodorus Antonius Maria Van Kleef (Amsterdam. Universiteit). Nov. 27, 1957. 72p.

The results of investigations on the Zeeman effect and on the configuration of Ir I are reported. A survey is first made of studies on the arc spectra of the elements of the 5d group made during the last ten years. Then the experimental work is described. Zeeman spectra were made in the region from 2300 to 8000 Å and spectra in zero magnetic field in the region from 2150 to 10600 Å. The analysis of the spectra is then discussed. Configuration calculations in the low even group were made using the theory developed by Condon and Shortley and by Racah. The theoretical and experimental values agree fairly well. Tables of composition and g-values are given. (J.S.R.)

27600 (PAN-217/V) ÜBER DEN ZUSAMMENHANG ZWISCHEN DER AUFNAHME DURCH ANIONENAUSTAUSCHER UND DER GROSSE DER KOMPLEXBILDUNGSKONSTANTEN VON ATHYLENDIAMINTE-TRAESSIGSAURE-KOMPLEXEN DER SELTEN ERDEN. (Relation Between the Uptake by Anion Exchanges and the Value of the Complex Formation Constants of Ethylene-diaminetetraacetic Acid Complexes of Rare Earths). M. Wald (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). March 1961. 26p.

The exchange behavior of EDTA complexes of the rare

earths on the strongly basic anion exchanger Dowex 1X4 was investigated with the radioisotopes La^{140}, Ce^{144}, Nd^{147}, Pm^{147}, $Eu^{152-154}$, Tb^{160}, Er^{169}, Tm^{170}, and Yb^{175}. The distribution coefficients of these complexes between EDTA-charged exchangers and EDTA-solutions and between extensively charged nitrate exchangers and EDTA-containing nitrate solutions were measured. In earlier works it was shown that between the intensity of the uptake of metal–EDTA complexes in a strongly basic anion exchanger and the magnitude of the stability constants of these complexes no direct relationship exists. The rare earth–EDTA complexes appear to be especially suitable for testing this hypothesis. In both the systems investigated it was found that the uptake of the rare earth–EDTA complexes up to europium (possibly up to the uninvestigated gadolinium) increases, then decreases abruptly notwithstanding the increasing values of the stability constants. The measurements refer to the pH range from 4.5 to 5; at higher pH values the separation factor increases for La and Nd. Infrared spectra of the free complex acids $H(Ln(enta)) \times H_2O$ were obtained for Nd, Sm, Ho, and Er. Possible origins of the exchange behavior of the Ln–EDTA complexes were discussed and traced back to the configuration changes of the chelates. A radiochemical separation of some rare earth metals in the form of their EDTA complexes on anion exchangers was described. (tr-auth)

27601 (SCNC-317) THE EFFECT OF SOLID SOLUTION ADDITIONS ON THE THERMAL CONDUCTIVITY OF UO_2. Richard M. Powers, Yolanda Cavallaro, and Joseph P. Mathern (Sylvania-Corning Nuclear Corp., Bayside, N. Y.). Nov. 1960. Contract AT-30-1-GEN-366. 128p.

Repetition of out-of-pile thermal conductivity measurements on UO_2 containing the additions CaO, Y_2O_3, and Nb_2O_5 showed lower thermal conductivities to result from the additions in every case tested. Thus, reductions of 22% at 500°C and 7% at 800°C were found from addition of 3.85 mole % Y_2O_3. The difference between these and earlier results that indicated a 30% increase in thermal conductivity at 800°C for the 3.85 mole % Y_2O_3 addition, is attributed to the effects of radiative heat transfer in the early thermal conductivity apparatus and to inadequate guarding. In-pile thermal conductivity tests showed that the average thermal conductivity between 350 and 2700°C was lowered 5 to 10% by 3.85 mole % additions of Y_2O_3. The number of effective carriers introduced into UO_2 by low valent additions found from resistivity measurements at temperatures up to 1400°C on UO_2 and on UO_2 containing 3.85 mole % Y_2O_3 was found to be far below that necessary to provide an electronic contribution to the thermal conductivity. The melting point of UO_2 under argon was found to be 2698°C. Spectral emissivities at 0.65 microns of 0.70 and 0.81 were also determined for UO_2. A solidus temperature of 2735°C and an emissivity of 0.80 was obtained for UO_2 containing 3.85 mole % Y_2O_3. In most cases, additives appeared to have little effect on the corrosion rate of UO_2 in 680°F steam at 2500 psi. Lattice parameters were found to decrease in proportion to the atom % of Y_2O_3 or CaO in the UO_2. (auth)

27602 (AEC-tr-4797) SPECTROSCOPIC BEHAVIOR, COMPLEXING CONSTANTS, AND BONDING STATES OF RARE EARTH-AMINOPOLYACETIC ACID COMPLEXES. L. Holleck. Translated from Österr. Chemiker-Ztg., 60: 65-9(1959). 18p.

The resolution of the absorption spectrum of rare earth complexes and the possibility of spectroscopically following the changes resulting from complex transformation and determining their composition are treated. Possible complex structures are discussed with the aid of molecular models. A relationship is established between the constant of formation obtained for a series of aminopolyacetic acid complexes and their paramagnetic susceptibilities. The diminution of ion susceptibility is illustrated by neodymium; this dimunution in turn is used as a measure of the covalent bond proportion and varies as does the complex constant for comparable complex types. In these cases there is a linear relationship between X_{nd} and log K. (auth)

27603 (AWRE/TRANS-17) REACTION OF RADIUM AND BARIUM WITH NITRILOTRIACETIC ACID IN AQUEOUS SOLUTION. B. P. Nikol'skii, A. M. Trofimov, and N. B. Vysokoostrovskaya. Translated by Jean Stuart for U.K.A.E.A. Atomic Weapons Research Establishment from Radiokhimiya, 1: No. 2, 155-61(1959). 18p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 9437.

27604 STRUCTURE OF U_4O_9. B. Belbeoch, C. Piekarski, and P. Perio (Centre d'Études Nucléaires, Saclay, France). Acta Cryst., 14: 837-43(Aug. 10, 1961). (CEA-1753)

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract No. 13385.

27605 THE CRYSTAL STRUCTURES OF $ThPb_3$, UPb_3, ThPb, AND UPb. Allan Brown (General Electric Co. Ltd., Wembley, Eng.). Acta Cryst., 14: 856-60(Aug. 10, 1961).

The compounds $ThPb_3$, UPb_3, ThPb, and UPb were prepared and their structures determined. Special precautions were taken to prevent oxidation during x-ray powder examination. $ThPb_3$ and UPb_3 are cubic, but, because of the small differences between the atomic scattering factors of lead, thorium, and uranium, it was not possible to distinguish directly whether the atomic arrangements are ordered or disordered. Evidence based upon lattice dimensions favors the ordered $L1_2$ structure. ThPb and UPb have a simple face-centered tetragonal crystal structure, which has a close geometrical relationship to the cubic structure of $ThPb_3$ and UPb_3. Possible atomic arrangements are discussed in terms of this relationship and atomic packing. It is concluded that ThPb and UPb are most appropriately described by a body-centered tetragonal structure of space group I4/amd. This structure is related to that of α-$ThSi_2$. (auth)

27606 MX_2 COMPOUNDS OF THORIUM AND THE POLYMORPHISM OF THORIUM DISILICIDE. Allan Brown (General Electric Co. Ltd., Hirst Research Centre, Wembley, Eng.). Acta Cryst., 14: 860-5(Aug. 10, 1961).

The crystal structures of phases with the composition ThX_2 were examined using x-ray powder and single-crystal techniques. Where X is Ni, Cu, Ag, Au, Zn, Cd, Al, or Si (β-$ThSi_2$) crystal structures of the C32-type are found. Where X is Si (α-$ThSi_2$) or Ga, the structures are of the C_c type. Related non-stoichiometric phases are $ThSi_{1.67}$ (defect C32-type), $ThGe_{1.5}$ (distorted, defect C32-type), and $ThGe_{1.62}$ (defect C_c type). Stoichiometric $ThGe_2$ is an A-face-centered orthorhombic structure. Consideration of these phases suggests that their crystal structures are influenced by the atomic radius r and the valency e of the X atom. Low values of e r are reflected in crystal structures of the C32-type. Si has a critical value of e r and $ThSi_2$ is dimorphic. Ge has the highest value of e r and $ThGe_2$ has an orthorhombic structure which may be derived from the C32 or C_c structures. The non-stoichiometric phases are formed at the boundary between two structure types. (auth)

27607 SYNTHESIS OF URANIUM DODECABORIDE. Yu. B. Paderno. Atomnaya Energ., 10: 396(Apr. 1961). (In Russian)

UB_{12} was obtained by the boron reduction of uranium oxide. The product is a gray metallic powder. The Debye x-ray phase analysis indicated the presence of a single phase at 1300 to 1900°C; the lattice dimension a = 7.472Å. (R.V.J.)

27608 ELECTROCHEMICAL REDUCTION OF U(VI) TO U(IV) IN HYDROCHLORIC ACID IN CONJUNCTION WITH CATION-EXCHANGE MEMBRANES. B. N. Laskorin and N. M. Smirnova. Atomnaya Energ., 10: 530-1(May 1961). (In Russian)

Kinetics of U^{6+} reduction to U^{4+} in hydrochloric acid solution containing 90 g/l uranium of current densities of 40 $\mu a/cm^2$ and 20 $\mu a/cm^2$ showed about 100% reduction with a graphite cathode. At 20 $\mu a/cm^2$ current density the reduction took 70 min; at 40 $\mu a/cm^2$ it took only 40 min. Similar results were achieved with solutions containing 140 g/l uranium. At a current density exceeding 40 $\mu a/cm^2$ the cathode potential becomes negative. (R.V.J.)

27609 CHEMICAL PROPERTIES OF SOME URANIUM COMPOUNDS IN FUSED ALKALINE CHLORIDES. Roger Molina (Ecole de Physique et Chimie, Paris). Bull. soc. chim. France, No. 6, 1184-90(June 1961). (In French)

The probable natures of uranium species at different degrees of oxidation in the fused eutectic LiCl–KCl are given. Some chemical reactions are described and interpreted with the aid of the classification of some complexes of the ion O^{2-} and of the thermal diagram for the system U(IV)/U(VI). The superposition of this diagram on that of sulfur also allows the interpretation of reactions between the species of sulfur and those of uranium. (tr-auth)

27610 THE SEPARATION OF METALLIC ELEMENTS BY ANION EXCHANGE RESINS. I. STUDY OF THE FIXATION OF SOME COMPLEX CHLORIDES. Bernard Tremillon (Ecole de Physique et de Chimie, Paris). Bull. soc. chim. France, 275-81(1961). (CEA-1942). (In French)

The quantitative fixation of zinc, cadmium, and mercuric chlorides on an anion exchange resin was studied. The element passes into the resin in the form of one of three principal complexes: MCl_2, MCl_3^-, or MCl_4^{2-}. In particular the fixation of MCl_2 to the resin results in a partition by the Donnan equilibrium. Consideration of the various equilibria operating show that the fixation of the element is a maximum when its proportion in the initial aqueous solution, in the form of the chargeless MCL_2, is a maximum. This point is verified experimentally. Curves representing the concentration of the element in the resin as a function of the solution concentration for various concentrations of sodium chloride were determined. In interpreting these curves, it is shown that cadmium is fixed to the resin almost entirely in the form of $CdCl_4^{2-}$ (total concentration in the solution below 0.2M); zinc is fixed simultaneously in the forms $ZnCl_3^-$ and $ZnCl_4^{2-}$, but less energetically; passage of mercury in the form $HgCl_2$ makes it possible to fix this element far more strongly than in the two other cases. The fixation of an element can be effectively deduced from a knowledge of the complex formation reactions in solution. The use of a mixed solvent water–acetone having a lower dielectric constant stabilises the complexes and facilitates the fixation of the element on the resin. Zinc chloride is fixed much more strongly in the presence of acetone, mainly in the form $ZnCl_4^{2-}$. Partition curves make it possible to find the valves for the partition coefficients observed in the elutriation conditions. (auth)

27611 THE SEPARATION OF METALLIC ELEMENTS BY ANION EXCHANGE RESINS. II. FRONTAL ANALYSIS AND DISPLACEMENT DEVELOPMENT OF ZINC AND CADMIUM CHLORIDES. Bernard Tremillon (Ecole de Physique et de Chimie, Paris). Bull. soc. chim. France, 281-6(1961). (CEA-1943). (In French)

The chromatographic frontal analysis and displacement development techniques were studied with a view to separating metallic elements using anion exchange resins. A certain number of conditions must be verified for obtaining the displacement of zinc chloride by cadmium chloride on an anion exchange resin column in the form of chlorides. These conditions are predictable from the partition curves previously determined. They concern the choice of the concentrations of cadmium and sodium chloride in the development solution. The theory is similar to that for chromatographic adsorption. For these to be displacement, the two elements must have the same partition coefficient. The sodium chloride concentration influences the shape of the partition curves, that of the cadnium chloride influences the value of the common partition coefficient. If the conditions are not established, the zinc chloride is elutriated by the developing solution. Frontal analysis and development experiments were carried out under the displacement conditions. They show that these two techniques have the same characteristics as in the case of other chromatographic methods, making it possible in particular to carry out separations for the preparation of these substances. (auth)

27612 RARE EARTH SILICATES. 4. NEW SILICATES IN La_2O_3–SiO_2 SYSTEM. N. A. Torpov and I. A. Bondar (Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 5, 739-44(May 1961). (In Russian)

A constitution diagram was constructed for La_2O_3–SiO_2, and three chemical compounds $La_2O_3 \cdot SiO_2$, $2La_2O_3 \cdot 3SiO_2$, and $La_2O_3 \cdot 2SiO_2$ were synthesized and studied. The lamination area and its boundaries were determined and compared with calcium and aluminum silicates. (R.V.J.)

27613 REACTIONS OF Ti, Zr, AND Ce HYDROXIDES WITH HYDROGEN PEROXIDE. S. Z. Makarov and L. V. Ladeinova (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 6, 958-64(June 1961). (In Russian)

Reactions of Ti, Zr, and Ce hydroxides with hydrogen peroxides were studied in a wide range of concentrations (0 to 98%) and from 0 to –20°C. Isotherms were constructed for the $Ti(OH)_4$–H_2O_2–H_2O system at 0 and –20°C, and data for $Ti(OH)_4$ reaction with H_2O_2 are tabulated. Only one phase of the peroxide type, with composition $TiO_3 \cdot 2H_2O$, was found. (R.V.J.)

27614 OSCILLATION SPECTRA AND STRUCTURE OF RARE EARTH SILICATES. A. N. Lazarev and T. F. Tenisheva (Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel, Khim. Nauk, No. 6, 964-73(June 1961). (In Russian)

The crystal structures of rare earth silicates $R_2O_3 \cdot SiO_2$, $2R_2O_3 \cdot 3SiO_2$, and $R_2O_3 \cdot 2SiO_2$ were studied, and infrared spectra are given for Ce, Dy, Er, Gd, La, Sc, Sm, Y, and Yb. The existence of $(SiO_4)^{4-}$ ions in ortho- and oxyorthosilicate and $(Si_2O_7)^{6-}$ in pyrosilicate compounds was established. Three types of structures were found different Si_2O_7 groups, depending on the nature of the cation. (R.V.J.)

27615 KINETIC STUDIES OF IODINE EXCHANGE BETWEEN HYDROGEN IODIDE AND CRYSTALLINE ALUMINUM IODIDE LABELLED WITH I^{131}. Ignacy Złotowski and Andrzej Polaczek (Univ. of Warsaw). Nukleonika, 6: 335-55(1961). (In English)

A study is made of the kinetics of iodine exchange between gaseous HI and crystalline AlI_3 labeled with I^{131}. The exchange reaction is effected at various pressures and temperatures. It is concluded that the obtained exchange diagrams are explainable by assuming that the process occurs by two independent paths: a slow exchange characterized by a mean rate constant $k \cong 5.10^{-7}$ sec^{-1}; and a rapid exchange strongly affected by structural factors and showing rates of progress by 2 to 4 orders of magnitudes higher than that of the slow one. The energy of activation is found to be practically the same (3.2 ± 0.2 kcal/mole) for both exchange processes. Based upon the measured pressure dependence of the slow exchange rate constant a relation $k = k_0 p^n$ is shown to exist with an experimental factor $n = 0.83 \pm 0.02$. It is suggested that both surface phenomena and gas diffusion in the AlI_3 solid phase are rate controlling processes in halogen exchange reactions between gaseous hydrogen halide and freshly formed aluminum halide layer. (auth)

27616 THE ELECTROREDUCTION OF URANIUM(VI) COMPOUNDS IN CARBONATE SOLUTIONS. Mieczysław Perec (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 357-69(1961). (In Polish)

The reduction of the uranyl carbonate ion to uranium oxide in aqueous solutions of Na_2CO_3 and $NaHCO_3$ at a lead electrode is investigated. The reduction rate increases with increasing temperature and pH, and decreases with increasing concentration of carbonate ions in the solution. It is found that the reduction of the $UO_2(CO_3)_2(H_2O)_2^{2-}$ ion at the mercury dropping electrode in carbonate solutions insignificantly depends on the concentration of carbonate ions and on pH of the solution. A mechanism for the uranyl carbonate ion reduction at the Pb electrode is proposed. (auth)

27617 ON THE POSSIBILITY OF A NEW PHASE-DETERMINING METHOD APPLYING THE MÖSSBAUER EFFECT. R. Srinivasa Raghavan (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sec. A, 53: 265-72(June 1961). (In English)

When soft γ rays are emitted without recoil, the radiation emitted has a considerable fraction contained within the natural line-width. This part of the radiation is expected to be partially coherent with the incident γ rays and with the Rayleigh scattered component. Under these conditions the total scattering amplitude will be a sum of the Rayleigh and Resonance amplitudes. This coherent addition leads to an enhancement of the intensities of Bragg reflections from the crystal. Since the total amplitude is complex, the intensities of inverse reflections will be unequal. It is suggested that this possibility be utilized, as in the similar case of anomalous dispersion of x rays, for determining the phase constants as also the absolute configuration of crystals. Practical limitations are discussed. (auth)

27618 EQUATION OF STATE OF HEAVY WATER IN LIQUID WATER IN LIQUID STATE. P. M. Kessel'man (Odessa Inst. of Marine Engineering, [USSR]). Teploenergetika, No. 4, 72-3(Apr. 1960). (In Russian)

The equation of state was developed for liquid D_2O. The equation describes the p-v-t relation and can be used in studies of thermodynamic properties. (R.V.J.)

27619 REGULARITIES IN SORPTION AND ION EXCHANGE ON AMPHOTERIC OXIDES AND HYDROXIDES. G. M. Zhabrova and E. V. Egorov (Inst. of Chemical Physics, Academy of Sciences, USSR). Uspekhi Khim., 30: 764-76(1961). (In Russian)

A review is given of the applications of amphoteric oxides and hydroxides as inorganic ion exchange and sorbent agents. Sorptive properties of various oxides and hydroxides of Fe, Ti, Zr, Zn, Sn, and other metals are analyzed, and the mechanism of ion exchange on oxides and hydroxides is discussed. (R.V.J.)

27620 MASS SPECTROSCOPIC DETERMINATION OF THE HEATS OF SUBLIMATION OF URANIUM TETRAFLUORIDE. P. A. Akishin and Yu. S. Khodeev (Moscow State Univ.). Zhur. Fiz. Khim., 35: 1169-70(May 1961). (In Russian)

The heat of sublimation of UF_4, measured with a mass spectrometer operating with an ion source and effusion chamber, was 71.45 ± 1.05 kcal/mol, which is in good agreement with published data derived by effusion measurements ($\Delta H_T = 73.5 \pm 1.1$ kcal/mol). (R.V.J.)

27621 ELECTRON DIFFRACTION STUDY OF THE STRUCTURE OF URANIUM TETRAFLUORIDE AND TETRABROMIDE MOLECULES IN THE VAPOR PHASE. N. G. Rambidi, P. A. Akishin, and E. Z. Zasorin (Moscow State Univ.). Zhur. Fiz. Khim., 35: 1171(May 1961). (In Russian)

The electronogram of UBr_4 disclosed a distorted tetrahedron of C_{2v} symmetry with even internuclear uranium–halide distance $z_g(U-Br) = 2.64 \pm 0.01$Å. For UBr_4 $\alpha = 90 \pm 3°$, $\beta = 124 \pm 3°$, and $\gamma = 105 \pm 3°$. (R.V.J.)

27622 RUTHENIUM TRIIODIDE. S. A. Shchukarev, N. I. Kolbin, and A. N. Ryabov (Leningrad State Univ.). Zhur. Neorg. Khim. 6: 1013-16(May 1961). (In Russian)

The interplanar distance in RuI_3 was determined, and the density of RuI_3 d_4^{20} was found to be 5.25 ± 0.02 g/cm^3. The thermal dissociation was examined at 590 to 660°K. The calorimetric heat of formation of solid RuI_3 from Ru_{metal} and I_{gas} is $\Delta H_{298} = 38.2 \pm 1.4$ kcal/mole. (R.V.J.)

27623 PURIFICATION OF TiO_2 AND METATITANIC ACID BY HIGH-VOLTAGE ELECTROLYSIS. V. A. Kargin, R. P. Lastovskii, T. A. Matveeva, D. I. Ryabchikov, V. A. Zarinskii, and M. M. Farafonov (Inst. of Pure Chemical Reagents, Academy of Sciences, USSR and Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim. 6: 1017-19(May 1961). (In Russian)

High-voltage electrodialysis was used for separating TiO_2 and metatitanic acid from admixtures in specimens containing less than 10^{-2}% Zr, Hf, and Ta; 5×10^{-4}% Mg; 10^{-3} Si; 10^{-4}% Fe; 3×10^{-3}% Al; and 10^{-4}% Ca, Cd, Cu, P, Pb, Sb, and Sn. (R.V.J.)

27624 COMPLEX COMPOUNDS OF PENTAVALENT NEPTUNIUM IN SOLUTIONS OF OXALIC AND ETHYLENDIAMINETETRAACETIC ACID. Yu. A. Zolotov, I. N. Marov, and A. I. Moskvin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 1055-62(May 1961). (In Russian)

The complexing of Np(V) with oxalic acid and ethylenediaminetetraacetic acid was studied by ion exchange. $NpO_2HC_2O_4$, $NpO_2C_2O_4^-$, and $NpO_2(C_2O_4)_3^{3-}$ with stability constants 5.0×10^2, 1.1×10^4, and 2.3×10^7 are formed in oxalate solutions at pH 2 to 5. The complex NpO_2Y^{3-} with stability constant $(4.9 \times 1.1) \times 10^9$ is formed in ethylenediaminetetraacetic acid at pH 5.3 to 5.6. (R.V.J.)

27625 INTRACOMPLEX COMPOUNDS OF URANYL WITH 8 HYDROXYQUINOLINE DERIVATIVES OF MANNICH TYPE. V. V. Zelentsov, E. P. Trailina, Yu. V. Glushko, I. A. Savich, and V. I. Spitsyn. Zhur. Neorg. Khim., 6: 1063-5(May 1961). (In Russian)

Uranyl complexes with 7-(m-nitroanilinobenzyl)-8 hydroxyquinoline, 7-(n-nitroanilinobenzyl)-8-hydroxyquinoline, 7-(n-aminobenzoic acid–benzyl)-8-hydroxyquinoline, 7-(m-nitroanilinofurfuryl)-8-hydroxyquinoline, and 7-(o-nitroanilinofurfuryl)-8-hydroxyquinoline were synthesized, and their solubilities in water at 25°C were determined. (R.V.J.)

27626 URANYL COMPOUNDS WITH TRIOXYGLUTARIC ACID. V. P. Markov and Z. M. Alikhanova. Zhur. Neorg. Khim., 6: 1066-73(May 1961). (In Russian)

A physico-chemical analysis was made of uranyl reactions with trioxyglutaric acid when U: $C_5H_8O_7$ was varied from 1:3 to 2:1. Five new compounds were prepared and analyzed: $UO_2C_5H_6O_7 \cdot 1.5H_2O$; $(UO_2)_2C_5H_4O_7 \cdot 4H_2O$; $(UO_2)_2C_5H_6O_7(HSO_4)_2 \cdot H_2O$; $NH_4(UO_2)_2C_5H_3O_7 \cdot 3H_2O$; $KO(UO_2)_2C_5H_3O_7 \cdot 3H_2O$; $Ba[(UO_2)_2C_5H_3O_7]_2 \cdot 12H_2O$; and $K_2UO_2C_5H_4O_7 \cdot 4H_2O$. $(NH_4)_2UO_2C_5H_4O_7 \cdot 2H_2O$. (R.V.J.)

27627 ON COMPLEX COMPOUNDS OF THORIUM WITH TRIOXYGLUTARIC ACID. O. E. Zvyagintsev and L. G. Khrominkov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR).. Zhur. Neorg. Khim., 6: 1074-83(May 1961). (In Russian)

Physico-chemical studies were made of thorium nitrate complexing with trioxyglutaric acid, sodium trioxyglutarate, and sodium bitrioxyglutarate in a wide range of pH. Preparations of thorium compounds with trioxyglutaric acid; $(ThOH)_2(H_3Gl)_3$, $Th(OH)H_2Gl \cdot 2H_2O$, $NaTh(OH)_2H_2Gl \cdot H_2O$, $NaTh(OH)(H_3Gl)_2$, and $Na_2Th(OH)_2(H_3Gl)_2$; are described. Structural formulas of the compounds are postulated, and the stability constant for $[ThH_3Gl]^{2+}$ was calculated. (R.V.J.)

27628 SYNTHESIS AND PROPERTIES OF RARE EARTH ORTHONIOBATES. E. I. Krylov, V. N. Sanatina, and A. K. Shtolts (Ural Polytechnic Inst., [USSR]). Zhur. Neorg. Khim., 6: 1135-7(May 1961). (In Russian)

La, Ce(III), Pr, and Nd orthoniobates were prepared, and their magnetic properties were investigated. It is shown that orthoniobates of the cerium subgroup have fergusonite structure, and at 195 to 293°K the molar magnetic susceptibility of $CeNbO_4$ proceeds according to the Curie law, while $PrNbO_4$ and $NdNbO_4$ follow the Curie-Wise law. (R.V.J.)

27629 PREPARATION OF TRIVALENT COMPOUND OF RHENIUM. D. I. Ryabchikov, V. A. Zarinskii, and I. I. Nazarenko. Zhur. Neorg. Khim., 6: 1138-41(May 1961). (In Russian)

Electrolytic reduction of Re(III) in solution is described. A cesium salt, Cs_3ReCl_6, was separated which indicates the presence of 6-coordinated hexahalide $ReCl^{3-}$. (R.V.J.)

27630 ELECTROMIGRATION OF ZIRCONIUM IONS IN PERCHLORIC, HYDROCHLORIC, AND NITRIC ACIDS. B. I. Nabivanets (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Zhur. Neorg. Khim., 6: 1150-4(May 1961). (In Russian)

The distribution of ionized zirconium between cations and anions is calculated, and variations in the number of electroneutral forms are determined as a function of acid concentration. Only cationic Zr was found in perchloric, hydrochoric, and nitric acids at $[H^+] \leq 0.5\underline{N}$. Anionic and neutral complex forms exist in hydrochloric and nitric acids at $[H^+] > 1.5\underline{N}$. The number of cations and anions are equalized at $C_{HCl} = 8$ to $9\underline{N}$ and at $C_{HNO_3} > 4\underline{N}$. The relative stability of anionic and neutral complexes increases according to $ClO_4^- < Cl^- \leq NO_3^-$. (R.V.J.)

27631 PHYSICO–CHEMICAL STUDIES OF RHENIUM SULFIDES. E. Ya. Rode and B. A. Lebedev (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 1198-1203(May 1961). (In Russian)

Thermographic, thermogravimetric, and x-ray-diffraction analyses were made of rhenium heptasulfide. Re_2S_7, prepared by hydrogen sulfide precipitation from potassium perrhenate in the presence of acid, is variable in composition and is saturated with sulfur in comparison with a stoichiometric composition of Re_2S_7 (up to $ReS_{3.75}$). Rhenium heptasulfide prepared by a wet method and not subjected to special thermal treatment is x-ray amorphous. ReS_2 crystallization, during decomposition of Re_2S_7, begins at 400°C and proceeds very slowly. The heptasulfide decomposition polytherm indicates the absence of any stable compounds between disulfide and heptasulfide. (R.V.J.)

27632 COMPLEX FORMATION IN BENZOYL ACETONE–ZIRCONIUM BENZENE–WATER AND HYDROLYSIS OF Zr IONS. V. M. Peshkova, N. V. Mel'chakova, and S. G. Zhemchuzhin. Zhur. Neorg. Khim., 6: 1233-9(May 1961). (In Russian)

Complexing zirconium with benzyl acetone was studied, and constants of dissociation and distribution were determined. (R.V.J.)

27633 DENSITY OF $ZrCl_4$ AND $HfCl_4$ IN VAPOR AND LIQUID STATES. L. A. Nisel'son. Zhur. Neorg. Khim., 6: 1242-4(May 1961). (In Russian)

The densities of the vapor and liquid states of zirconium and hafnium tetrachlorides were determined, and temperature maximums were found for the direct rectification of the pure compounds. (R.V.J.)

27634 RHODANATE URANYL COMPOUNDS WITH TRIETHYLENEDIAMINOCOBALT. V. P. Markov and E. N. Traggeim (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 1244-6(May 1961). (In Russian)

New uranyl rhodonide compounds were synthesized using triethylenediaminocobalt as cation. A complex uranyl hexarhodonide $[Co(En)_3]_2[UO_2(CNS)_6(NO_3)_2 \cdot 5H_2O$ was established. Other complex compounds found had the following empiric formulas: $[Co(En_3)NH_4 \cdot UO_2(CNS)_5NO_3$; $[Co(En)_3]CH_6N_3 \cdot UO_2(CNS)_5NO_3 \cdot H_2O$; and $[Co(En)_3]NH_4 \cdot UO_2(CNS)_5Cl$. (R.V.J.)

27635 PREPARATION OF $OsBr_3$. S. A. Shchukarev, N. I. Kolbin, and I. N. Semenov. Zhur. Neorg. Khim., 6: 1246-7(May 1961). (In Russian)

$OsBr_3$ appears as a dark-gray, non-hygroscopic, water-insoluble powder with a density of $d_4^{20} = 6.32$. $OsBr_3$ dissociates into metal and bromide in vacuum at 340°C. (R.V.J.)

27636 POLARIZATION OF LIQUID BISMUTH CATHODE IN CHLORIDE MELTS. I. F. Nichkov, S. P. Raspopin, and Yu. V. Bazhkov. Zhur. Priklad. Khim., 34: 1533-6(July 1961). (In Russian)

Polarization of a liquid bismuth cathode in alkali metal chloride melts, with and without additions of bismuth and uranium chlorides, at 700° and low current density show that the uranium ion reduction process $U^{4+} + e \rightarrow U^{3+}$ takes place at more positive potentials than the bismuth ion reduction process. $Bi^{3+} + 3e \rightarrow Bi$ occurs in electrolytes with low bismuth chloride concentration. It is also shown that separation of alkali metal on bismuth cathode occurs at more positive potentials (about 0.5 v) than on molybdenum cathode. (R.V.J.)

27637 IMPROVEMENTS IN AND RELATING TO POLYMERIZATION. (to B. F. Goodrich Co.). British Patent 874,168. Aug. 2, 1961.

A process for preparing mechanically stable, thermosetting, water-soluble interpolymers of alpha-beta olefinically unsaturated carbonyl monomers by polymerization is described. The monomers are polymerized in an anhydrous aliphatic alcohol (ethanol, isopropanol, or n-butanol) in the presence of a free radical polymerization initiator at a temperature in the range 50 to 100°C. Water is added to the reaction product together with a volatile neutralizing agent (ammonia) and the mixture is subjected to azeotropic distillation. The interpolymer is cured by heating between 100 to 180°C, preferably at 160°C, for 5 to 30 minutes. The resulting interpolymer has a pH of from 6 to 7. The interpolymer has the general formula $(CH_2=CRCOOH)_n(CH_2=CR_1CONHCH_2OH)_x$ $(CH_2=CHCOOR_2)_y(CH_2=CCH_3COOR_3)_z$, wherein R and R_1 each represents hydrogen or methyl; R_2 represents methyl, ethyl, propyl, or butyl; R_3 represents methyl or ethyl; n represents from 3 to 12 weight percent based on the combined weight of n, x, y, and z; x represents from 8 to 25 per cent; y represents from 45 to 89 per cent; z represents from 0 to 44 per cent; the sum of n, x, y, and z is always 100 and is present in the polymer in a heterogeneous relative order. (N.W.R.)

Radiation Chemistry and Radiochemistry

27638 (AD-256188) DEVELOPMENT OF TRANSPARENT PLASTIC MOISTURE BARRIERS BY RADIATION-INDUCED GRAFT COPOLYMERIZATION. Bimonthly Report for December 1960–January 1961. (Radiation Applications Inc., Long Island City, N. Y.). Feb. 3, 1961. Contract NOw-61-0407-c. 7p.

Procedures were developed for chlorinating polyethylene using u-v and γ rays. It appears that the proper degree of chlorination can reduce the water permeability of polyethylene. Water vapor transmission rates for untreated polyethylene were determined. (auth)

27639 (AFOSR-732) STRUCTURE OF DEFECT CLUSTERS IN SOLIDS. Terminal Report. John W. Buttrey (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 12, 1961. Contract AF49(638)-829. 32p. (AD-258384)

A review of the work done on irradiation of LiF is presented. Small-angle x-ray scattering studies were made on neutron-irradiated LiF, neutron-irradiated Si, and Li-doped Si. Preliminary results indicate some small-angle x-ray scattering from irradiated LiF, but none at all from irradiated Si and Li-doped Si. (D.L.C.)

27640 (ASD-TR-7-840A(II)) HYDRAZINE PROCESS DEVELOPMENT. Interim Technical Engineering Report, April through July 1961. J. H. Cusack, L. G. Carpenter, R. I. Miller, R. L. Pearson, F. R. Standerfer, and H. T. Watanabe (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AF33(600)-42996. 172p.

A program is described for the development, design, construction, and operation of a continuous in-reactor hydrazine production loop based on a fissio-chemical processing approach. The history, organization, and detailed goals of the program are summarized. Theoretical background, specific requirements, and initial experimental approaches in the task areas of fuel separation, product concentration, gas disengagement, materials testing, in-reactor engineering, and radiolysis mechanisms are discussed. (auth)

27641 (NP-10561) RESEARCH ON SOLID STATE RADIATION-INDUCED PHENOMENA. Quarterly Progress Report No. 5, February, March, and April. Hartmut Kallmann (New York Univ., New York). June 1961. Contract DA 36-039 SC-85126. 35p.

Gamma Ray-Induced Fluorescence of p-Oligophenylenes. The gamma ray-induced fluorescence of methyl and methoxy substituted p-oligophenylenes is studied. These substitutions in many cases considerably increase the solubility in solvents effective for energy transfer so that relatively complicated molecular structures can be studied. The methyl substitution does not greatly change the fluorescence intensity, but the methoxy substitution greatly enhances the fluorescence in some cases. Introduction of CCl_4 as a quencher gives results which differ somewhat from the usual behavior found with other solutes. Simultaneous Luminescence and Impedance Measurements of ZnS Phosphors Under Illumination with X Rays. Investigations of the glow curves of Zn-S-Ag show that this phosphor has four maxima in conductivity and three maxima in luminescence in the temperature range of liquid nitrogen to room temperature. The luminescence maxima occur at lower temperatures than the conductivity maxima. One conductivity maxima seems to be due to a hole conductivity, thus emptying an activator level. Under excitation at various stable temperatures between liquid nitrogen and room temperature, the shallowest maxima in the glow curves are lost more and more. The same effect could be obtained with i-r illumination of various wavelengths at liquid nitrogen temperature. Temperature Dependence of Intensity of Fluorescence. The variation of intensity of fluorescence with temperature was measured for a number of organic solutions. The intensity of fluorescence was found in all cases to decrease with increasing temperature and at 200°C was about one fourth of that at 25°C. The rate of decrease depends upon the solvent, the solute, and the concentration. (auth)

27642 (NYO-9419) A COMPARISON OF RADIATION-INDUCED GRAFT COPOLYMERIZATION UTILIZING ELECTRON ACCELERATORS AND ISOTOPE SOURCES AS RADIATION INITIATORS. Quarterly Report for the Period April 18, 1961 to July 17, 1961. George Odian, William F. Oliver, and Earl Pierre (Radiation Applications Inc., Long Island City, N. Y.). Sept. 12, 1961. Contract AT(30-1)-2636. 8p.

Styrene–methacrylic acid mixed in 1:2 mole ratio was graft copolymerized on to 2- and 5-mil polypropylene films by Co^{60} and electron accelerator irradiations. The grafting rates indicate that, except at the lowest Co^{60} dose rate, the grafting reaction is mainly a surface reaction. (D.L.C.)

27643 (ORO-464) INFRARED SPECTRA OF PLASTICS AND ELASTOMERS AFTER NUCLEAR IRRADIATION. W. C. Sears (Georgia. Univ., Athens). Sept. 9, 1960. Contract AT(40-1)-2418. 15p.

Data for the infrared spectrum of irradiated polyethylene are summarized, and infrared spectra are presented for rubber hydrochloride, polypropylene, and vinyl chloride–vinylidene chloride copolymer films before and after irradiation to 4 to 7×10^8 rads. Band assignments are presented for unirradiated films of various polymers. (D.L.C.)

27644 (PAN-228/XIII) DIE METHODEN DER TRENNUNG VON RADIOISOTOPEN IN SPURENMENGEN. I. FOKUSSIERENDER IONENAUSTAUSCH. TRENNUNG VON ^{46}Sc UND ^{45}Ca. (Methods of Separation of Radioisotopes in Trace Quantities. I. Focussed Ion Exchange Separation of Sc^{46} and Ca^{45}). A. Pasternak and K. Zelenay (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). May 1961. 11p.

A fast separation method for trace amounts of Sc and Ca

was worked out using focussed ion exchange. (Sc^{46} and Ca^{45} are the products of neutron irradiation of Sc_2O_3.) The optimum conditions are 0.25 M citric acid solution as complex agent, pH 3.9, current potential 500 v (drop 36 v/cm), current ~20 mamp, and separation time 4 to 8 min. The method has both analytical and preparative significance especially in the preparation of Ca^{45} for medical aims. (tr-auth)

27645 (WADD-TR-59-661) EVALUATION OF BUNA-N (NBR) GASKETS IN PROTOTYPE APPLICATIONS UNDER GAMMA FLUX. [Period Covered] September 1957–January 1959. John A. Parker and Denver Hale (Wright Air Development Div. Materials Central, Wright-Patterson AFB, Ohio). July 1960. 34p.

Both qualitative and quantitative sealability tests were evaluated to test the theoretical prediction of the stability of certain acrylonitrile-butadiene rubber stocks. Reasonable agreement between sealability coefficients was obtained from the seal tester and relative replacement times over a dose range from 2×10^9 to 2×10^{10} ergs/g carbon (one roentgen = 87.7 ergs). Evaluation criteria for these compositions were established by application of the Bopp-Sisman relationship to observed changes in the elastic modulus. The effect of ferrocene as a potential "anti-rad" was investigated and found to improve the radiation resistance of these stocks. (auth)

27646 (CEA-tr-R-1348) SUR L'INFLUENCE DE LA RADIOACTIVITÉ DES PRÉCIPITÉS SUR LEURS PROPRIÉTÉS DE SORPTION. (Influence of the Radioactivity of Precipitates on Their Sorptive Properties). V. I. Spitsyn (Spitzin) and V. V. Gromov. Translated into French from Radiokhimiya, 1: No. 2, 181-4(1959). 12p.

The effect of radioactive additions (S^{35} and Ra) on the adsorptive properties of barium sulfate was studied with respect to some colorants. It was established that, with the increase of the specific activity of $BaSO_4$ labeled with S^{35}, the value of the adsorption of methylene blue decreases and that of acid orange increases. The inverse relationships were observed in $BaSO_4$ precipitates in the presence of radium. An hypothesis is proposed according to which these phenomena depend on the appearance of charges at the surface of the $BaSO_4$–positive in the case of β particles and negative in the case of α particles. (tr-auth)

27647 (CEA-tr-R-1354) ETUDE DES RÉACTIONS DES RADICAUX LIBRES DANS LE POLYTÉTRAFLUORÉTHYLÈNE IRRADIE. I. APPLICATION DE LA MÉTHODE DE RÉSONANCE ÉLECTRONIQUE PARAMAGNÉTIQUE POUR ÉTUDIER LA TRANSFORMATION DES RADICAUX ET POUR DÉTERMINER LE COEFFICIENT DE DIFFUSION DE L'OXYGÈNE DANS LE POLYTÉTRAFLUORÉTHYLÈNE. (Study of Reactions of Free Radicals in Irradiated Polytetrafluoroethylene. I. Application of the Paramagnetic Electron Resonance Method for Studying Radical Transformation and for Determining the Diffusion Coefficient of Oxygen in Polytetrafluoroethylene). Yu. (Ju.) D. Tsvetkov, Ya. (Ja.) S. Lebedev, and V. Voevodskii (Voevodskij). Translated into French from Vysokomolekulyarnye Soedinenya, 1: 1519-25(1959). 23p.

The method of paramagnetic resonance was applied to the study of the reactions of radicals in the solid phase with molecules in the gaseous phase. A method for the calculation of kinetic and diffusion constants from the paramagnetic electron resonance spectra is proposed. The diffusion processes of oxygen in teflon exposed to radiation was studied, and the values of the pre-exponential multiplier D_0 and of the diffusion activity energy ϵ_D were found. (tr-auth)

27648 DIRECT QUANTITATION ON PAPER CHROMATOGRAMS OF RADIOACTIVITY FROM C^{14} LABELLED FATTY ACIDS. Heinz J. M. Hansen (Danish Atomic Energy Commission, Research Establishment, Risö, Denmark). Acta Chem. Scand., 15: 670-4(1961). (In English).

Experiments were conducted using reversed phase chromatography with horizontal development. It was shown by varying spot size and type of fatty acid that the marginal distribution throughout the thickness of the paper of the molecules to be counted renders no bias to their quantitative evaluation. The said marginal distribution, however, influences the scanning error and it can be recommended to scan low energy labelled paper chromatograms from both sides of the paper and average the results. (auth)

27649 PRELIMINARY OBSERVATIONS OF A PARTICULAR EFFECT OF NUCLEAR RADIATION ON ELECTRODE PROCESSES. Loris Busulini. Atti accad. nazl. Lincei. Rend., Classe sci. fis., mat. e nat., 30: 53-4(Jan. 1961). (In Italian)

By the use of radiation sources, useful information should be obtainable on the mechanism of electrode processes. This preliminary work relates the primary results obtained from a program of research on the chemical effects produced by radiations. The first measurements were made in an aqueous medium using α radiation. The electrochemical reduction of a ferric salt with a metal proceeds with the intermediate formation of bivalent iron. A current increase is observed in the use of radioactive electrodes. In the presence of H_2O_2 the electrochemical reduction reaction of a ferric salt proceeds by a mechanism of kinetic character. (J.S.R.)

27650 RADIATION-INDUCED REACTION IN AN AQUEOUS BENZOIC ACID SOLUTION. I. DOSE AND DOSE RATE DEPENDENCIES OF SALICYLIC ACID, AND OF BIPHENYLDICARBOXYLIC ACIDS. Akihisa Sakumoto and Gen-ichi Tsuchihashi (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 34: 660-3(May 1961). (In English)

Dose and dose rate dependencies of the yield of salicylic acid, and of biphenyldicarboxylic acids were studied in the presence or the absence of molecular oxygen when aqueous solutions of benzoic acid were irradiated with Co^{60} gamma rays. In the presence of molecular oxygen, the yield of salicylic acid was greater than that in the absence of molecular oxygen and biphenyldicarboxylic acids were not produced, whereas in the absence of molecular oxygen the main products were biphenyldicarboxylic acids. Some mechanisms are also discussed. (P.C.H.)

27651 RADIATION-INDUCED REACTION IN AN AQUEOUS BENZOIC ACID SOLUTION. II. DETERMINATION OF PRODUCTS BY ISOTOPE DILUTION METHOD. Akihisa Sakumoto and Gen-ichi Tsuchihashi (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 34: 663-7 (May 1961). (In English)

The radiolysis of aqueous solutions of benzoic acid (carboxyl-C^{14}) in the presence or the absence of molecular oxygen was studied. Tables are given showing the yields of products and G-values in both oxygen-free and oxygen-saturated solutions. The yield of products in the presence of oxygen was quantitatively and qualitatively different from those in the absence of oxygen. The primary process of the mechanism of the reaction is assumed to be radiolytic decomposition of water. A detailed discussion is given on the mechanism of the radioinduced reaction. (P.C.H.)

27652 THE RADIOLYSIS OF CYCLOHEXANE. IV. BINARY MIXTURES IN THE VAPOR PHASE. J. M.

Ramaradhya and G. R. Freeman (Univ. of Alberta, Edmonton). Can. J. Chem., 39: 1769-75(Sept. 1961).

The variation of the hydrogen yield with the composition of binary gaseous mixtures containing cyclohexane and benzene, cyclohexene, or propylene is qualitatively similar to that in the liquid phase. The quantitative experimental data were tested against several possible reaction mechanisms and two mechanisms gave straight-line plots. One mechanism involved scavenging of hydrogen atoms. The second mechanism involved the transfer of energy (excitation or ionization) from cyclohexane to the second substance. The values of the ratio of the rate constants, k_7/k_6, of the reactions $C_6H_{12}^{**} \rightarrow H_2$ + products, and $C_6H_{12}^{**} + P \rightarrow C_6H_{12} + P^*$ were about 10^3 times greater in the gas than in the liquid phase. Consideration of possible detailed mechanisms of these reactions indicated that this difference is reasonable if $C_6H_{12}^{**}$ is a positive ion rather than an excited molecule. (auth)

27653 THE RADIOLYSIS OF ETHANOL. I. VAPOR PHASE. J. M. Ramaradhya and G. R. Freeman (Univ. of Alberta, Edmonton). Can. J. Chem., 39: 1836-42(Sept. 1961).

The alpha radiolysis of ethanol vapor at 108°C produced hydrogen as the major single product, with smaller amounts of methane, carbon monoxide, ethylene, ethane, acetaldehyde, formaldehyde, water, 2,3-butanediol, 1,2-propanediol, propanol, and butanol. The intial yield of hydrogen was $G(H_2) = 8.9 \pm 0.4$, which is much higher than the values reported for the liquid phase ($G(H_2) \approx 4$). A mechanism is proposed to account for the formation of the products. However, the observed value of $G(H_2O) = 5.4$ is over four times larger than can be explained by the mechanism. There is a good material balance in the observed reaction products, which indicates that little polymerization occurred during the radiolysis. This is in marked contrast with the vapor phase radiolysis of cyclohexane. (auth)

27654 THE RADIOLYSIS OF ETHANOL. II. BINARY VAPOR MIXTURES. J. M. Ramaradhya and G. R. Freeman (Univ. of Alberta, Edmonton). Can. J. Chem., 39: 1843-7(Sept. 1961).

Benzene and cyclohexene cause a marked decrease in the hydrogen yield from the vapor phase radiolysis of ethanol. The experimental data were tested against the two reaction mechanisms that gave straight-line plots for the corresponding cyclohexane–protector systems. Both of these mechanisms also gave straight-line plots for the ethanol–protector systems. One mechanism involved scavenging of hydrogen atoms. The values of the kinetic parameters derived from this mechanism are quite similar in the cyclohexane and ethanol systems. The second mechanism involved the transfer of energy (excitation or ionization) from ethanol to the protector. The values of the kinetic parameters derived from this mechanism showed some differences between the ethanol and cyclohexane systems. One possible reason for the lack of resolution between the two reaction mechanisms might be that they both occur to comparable extents. Two mechanisms appear to occur to comparable extents in the liquid cyclohexane system. (auth)

27655 RADIOCHEMICAL ISOLATIONS. I. ISOLATION OF HAFNIUM AND TUNGSTEN AS SPALLATION PRODUCTS OF TANTALUM. M. Vobecký and A. Maštalka (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Collection Czechoslov. Chem. Communs., 26: 1716-19(June 1961). (In German)

Radioisotopes of hafnium and tungsten were obtained as spallation products of tantalum bombarded with 600-Mev protons. The hafnium was separated without carrier, and the tungsten was of radiochemical purity. The methods used are described. (J.S.R.)

27656 RADIATION-THERMAL CRACKING OF LIQUID HYDROCARBONS. A. M. Brodskii (Inst. of Oil Technical-Chemical Synthesis, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 1143-6(June 11, 1961). (In Russian)

The effect of high-energy radiation and heat on a natural hydrocarbon mixture (crude oil fractions boiling at 200 to 350°C) was studied by irradiating hydrocarbon samples sealed in quartz ampoules in the VVR reactor. Below a certain limiting temperature T_p (approximately 600°K) the G value (the number of molecules destroyed per 100 ev of energy absorbed) varies very little with an increase in temperature. The G value increases sharply with an activation energy of 20 ± 5 kcal from 600°K and up. With a further increase in temperature, thermal cracking begins to predominate. The amount of decomposition depends not only on the total amount of energy absorbed, but also on the dose strength, that is, on the residence time in the reaction zone. The yield of high molecular-weight products decreases sharply but the yield of gaseous products increases, as the temperature is increased above 600°K. In order to explain this behavior, it is assumed that there are two different kinds of reactions taking place: 1) a hydrocarbon molecule plus radiation react to give an excited molecule which decomposes to a stable end product and 2) a hydrocarbon molecule plus radiation react to give a thermal hydrocarbon radical which reacts with other radicals to give various products. It is assumed that the formation of an excited molecule (process I) does not depend on temperature, since the excitation energy is much greater than the value of k T. Two types of radical reactions are distinguished. Below 600°K (the critical temperature) the radicals are stable, and are subject primarily to a recombination reaction. Above 600°K the radicals decompose with the formation of olefins and low molecular-weight radicals which decompose further. With these assumptions equations are developed that give the critical temperature and the dimensions of the reaction zones. A detailed study of radiation-thermal cracking in liquid hydrocarbons can be used to determine the elementary processes occurring during the interaction of radiation with matter. (TTT)

27657 THE INHIBITING EFFECT OF URANYL ION ON THE RADIATION-CHEMICAL OXIDATION OF DIVALENT IRON. V. G. Firsov (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 1155-7(June 11, 1961). (In Russian)

Carefully degassed, sulfuric acid solutions containing uranyl sulfate were subjected to irradiation from a Co^{60} source having a radiation intensity of 1.5×10^{19} ev/l-sec. The results of the measurements showed that there was a significant drop in the oxidation yield of Fe^{2+} with an increase in concentration of UO_2^{2+} and with a decrease in concentration of H^+. The inhibitory effect of uranyl ion is apparently due to the following reactions: 1) $UO_2^{2+} + H \rightarrow UO_2^+ + H^+$ and 2) $UO_2^+ + OH \rightarrow UO_2^{2+} + OH^-$. On assuming steady-state and $G\,H_2^+ = 0$, it was found that the G value is a function of only the concentrations of H^+ and UO_2^{2+} and not of the concentration of Fe^{2+}:

$$\frac{k_4[H^+]}{k_6[UO_2^{2+}]} = \frac{\frac{1}{2}G - k}{n + k - \frac{1}{2}G} = F\,(G)$$

The agreement between theory and experiment was excellent. (TTT)

27658 MECHANISMS OF HOT HYDROGEN ATOM DISPLACEMENT REACTIONS WITH ALKANES. David Urch and Richard Wolfgang (Yale Univ., New Haven). J. Am. Chem. Soc., 83: 2982-91(July 20, 1961).

Recoil tritium from nuclear reaction was used as the source of hot hydrogen and iodine or oxygen served as scavengers to suppress interference from the minority of tritium atoms that reach thermal energies. 99.5% of the products may be accounted for by replacement of one or possibly two hydrogen atoms or alkyl groups by the incoming hydrogen. The detailed product spectrum provides strong support for a model of the mechanism in which the incoming hydrogen displaces another group directly, without forming any metastable intermediate. The point and direction of impact as well as the energy of the hot species is thus paramount in determining the course of the reaction. The greater tendency to break C–H rather than C–C bonds is due to the greater exposure of the former. Other details in product distribution may be explained similarly by variations in steric obstruction to certain modes of impact. Hydrogen atom abstraction appears to follow axial approach of the hot atom along the C–H bond axis; while displacement occurs (without Walden inversion) as a result of attack at larger angles to the bond axis. (auth)

27659 STEREOCHEMISTRY OF HOT HYDROGEN DISPLACEMENT AT sp^3 CARBON–HYDROGEN BONDS. Michael Henchman and Richard Wolfgang (Yale Univ., New. Haven). J. Am. Chem. Soc., 83: 2991-6(July 20, 1961).

The stereochemistry of the displacement of hydrogen by hot hydrogen atoms has been studied at an sp^3 carbon atom in a gaseous molecule. The system used was the reaction of recoil tritium, from the nuclear reaction $He^3(n,p)H^3$, with optically active 2-butanol. There is 91 ± 6% retention of configuration for displacement of the hydrogen atom directly bonded to the asymmetric carbon. For the displacement of all the hydrogens throughout the molecule, there is 94 ± 3% retention of configuration. These results are well in accord with the model of hot hydrogen displacement postulating a fast, localized interaction occurring in about the characteristic period of a C–H bond vibration. According to such a model the short duration of the collision and the small size of the hydrogen atom allow no effective coupling mechanism for the concerted excitation of the several vibrational modes involved in the inversion process. (auth)

27660 HOT HYDROGEN ATOM DISPLACEMENT REACTION AT ETHYLENIC C–H BONDS. David Urch and Richard Wolfgang (Yale Univ., New Haven). J. Am. Chem. Soc., 83: 2997-8(July 20, 1961).

Reaction of hot hydrogen atoms to replace hydrogen atoms in cis and trans dichloroethylenes proceeds with 70% retention of the original configuration. This indicates the existence at sp^2 C–H bonds, of a fast single-step displacement mechanism, not involving a common intermediate, and similar to that previously found in saturated systems. The isomerization that does occur can result from rotation about the double bond of product molecules excited in the primary displacement. A hot hydrogen double bond addition mechanism may also yield isomerized dichloroethylenes. (auth)

27661 STRUCTURE AND REACTIVITY IN THE RADIOLYSIS OF KETONES. J. N. Pitts, Jr. and A. D. Osborne (Univ. of California, Riverside). J. Am. Chem. Soc., 83: 3011-14(July 20, 1961).

A series of six ketones was subjected to radiolysis at 25° with 3 Mev gamma rays. The compounds were: methyl n-propyl, methyl n-butyl, methyl n-amyl, methyl cyclopropyl, dicyclopropyl, and methyl propenyl ketones. Detailed product analysis was carried out and G-values for the various products are reported. With methyl n-propyl, methyl n-butyl, and methyl n-amyl ketones, degradation into radicals and an intramolecular formation of acetone and olefin are the main processes. Thus for methyl n-propyl ketone G(CO) = 0.38, $G(CH_4)$ = 0.42, $G(C_3H_8)$ = 0.36, $G(C_2H_4)$ = 0.15, and G(acetone) = 0.13. Methyl n-propyl ketone also gives rise to appreciable amounts of acetaldehyde (G = 0.12) and propylene (G = 0.09). With the cyclopropyl an unsaturated compound photorearrangement to an isomer is the main process, and there is little gaseous product. Dicyclopropyl ketone is particularly stable toward radiolysis. ΣG(gaseous product) = 0.36 compared to 1.88 for methyl n-propyl ketone. (auth)

27662 CHEMICAL ACTIONS OF IONIZING RADIATIONS ON AQUEOUS SOLUTIONS OF VANADIUM. IV. INFLUENCE OF Cl^- IONS ON THE REDUCTION OF ACID SOLUTIONS OF PENTAVALENT VANADIUM BY γ RAYS. Jacques Pucheault and Christiane Ferradini (Institut du Radium, Paris). J. chim. phys., 58: 606-12(June 1961). (In French)

The effects of Cl^- ions on the radical and molecular yields of the radiolysis of water were determined with the aid of the V^{5+}/V^{4+} system in 0.8N H_2SO_4 solutions irradiated by Co^{60} γ rays in the presence of air and variable quantities of KCl. A reaction scheme is proposed. The kinetic study permits the interpretation of the reduction of V^{5+} and its variations according to the concentration in V^{4+}. As a function of the 1/3 power of the Cl^- concentration, the curve indicating the yield of this reduction is decomposed into two lines of different slopes. This is attributed to the existence of two distinct processes for the formation of molecular H_2O_2 in the clusters. (tr-auth)

27663 ESR SPECTRA OF IRRADIATED POLYVINYLALCOHOL AND ITS RELATED COMPOUNDS. Seiji Ogawa (Japanese Assn. for Radiation Research on Polymers, Tokyo). J. Phys. Soc. Japan, 16: 1488-9(July 1961). (In English)

The ESR spectrum of γ-irradiated polyvinylalcohol is a superposition of two types of patterns easily separated at suitable conditions. One is a triplet pattern spaced by 35 gauss; the other is a diffuse singlet with longer life at room temperature but with more rapid decay near the second-order transition temperature than the former. (L.N.N.)

27664 IRRADIATION OF SINGLE CRYSTAL POLYETHYLENE. Ronald Salovey (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Polymer Sci., 51: No. 156, S1 (June 1961).

A soluble, irradiated single crystal material was crystallized from dilute xylene solution in a light-scattering photometer. It was found that the induction period was much longer and the rate of the subsequent isothermal crystallization much slower than for the unirradiated material. Thus the incidence of intramolecular crosslinking and possibly some interlamellar crosslinking impeded folding and depressed the rate of diffusion of polymer molecules to crystallizing sites. (P.C.H.)

27665 NUCLEAR MAGNETIC RESONANCE IN POLYVINYL ALCOHOL IRRADIATED BY THERMAL NEUTRONS. Shizuo Fujiwara (Univ. of Electro-Communications, Tokyo). J. Polymer Sci., 51: No. 156, S15-S18(June 1961).

Powdered PVA samples, annealed or not annealed and of various degrees of polymerization, were irradiated. The results of the experiment are summarized in a table which gives the position of the sample in the pile, period of radiation, $\bar{P}$ of PVA (with and without heat treatment, total of γ ray dose × 10^6, rads from dosimetry, and calculated from $\bar{P}$ change. The NMR measurements revealed the effects of neutron irradiation, contrary to the results obtained from the $\bar{P}$ data. Detailed discussion is given of the table and also of the NMR spectra obtained at 17°C. Results of the

spectra, which show that the relative intensities of the broad components in all samples are much reduced by irradiation, suggest that the destruction of the broad components is caused by the thermal neutron irradiation and not by γ rays. (P.C.H.)

27666 CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATION. F. Baumgärtner (Technische Hochschule, Munich). Kerntechnik, 3: 297-301(July 1961). (In German)

If an atom as part of a chemical compound is subjected to a nuclear reaction, it usually undergoes chemical changes as well. A summary is made of the experimental findings on halogen compounds, as well as crystalline molecular and ionic compounds, after neutron capture reactions. (auth)

27667 HARTECK'S TESTS FOR THE APPLICATION OF NUCLEAR ENERGY TO CHEMICAL PROCESSES. Hans Teggers. Kerntechnik, 3: 312-16(July 1961). (In German)

Intensive theoretical and experimental work on topics anticipating the use of the kinetic energy of nuclear fragments for inducing chemical reactions, especially for the production of nitrogen dioxide from the air, has been done. The most important experimental results as well as their possible effects on the production of chemical products are reported. (auth)

27668 KINETICS OF RADIATION INDUCED SOLID STATE POLYMERIZATION OF CYCLIC MONOMERS. Koichiro Hayashi and Seizo Okamura (Japanese Assn. for Radiation Research on Polymers, Osaka). Makromol. Chem., 47: 230-6(1961). (In English)

It was previously found that cyclic monomers polymerize by radiation only in the presence of an ionic catalyst. Therefore the ionic mechanism was studied. The polymerization rate was found to be proportional to the radiation dose rate at 1st order but in these cases the saturation of polymer yield was observed. The effects of temperature were determined. The post polymerization was found. It was concluded that the radiation induced ionic polymerization of cyclic monomers take place more easily at rigid crystalline state on the contrary to the cases of radial polymerization. Kinetics are proposed for the saturation yield due to the disordering monomer crystal induced by the formed polymer. (M.C.G.)

27669 CRYSTALLINE POLYMERS PREPARED BY THE RADIATION INDUCED SOLID STATE POLYMERIZATION. Koichiro Hayashi, Yasuhisa Kitanishi, Masanobu Nishii, and Seizo Okamura (Japanese Assn. for Radiation Research on Polymers, Osaka). Makromol. Chem., 47: 237-41(1961). (In English)

It was found that the polymers obtained from the monomer in a large single crystalline state had higher melting points than those obtained in an aggregate state of small crystals. X-ray-diffraction analysis was made on these polymers for estimating their structures. Polydiketene, poly-β-propiolactone, and polyoxymethylene structures are discussed. (M.C.G.)

27670 ELECTRON SPIN RESONANCE OF $(CO_2H)CH_2CH_2\dot{C}H(CO_2H)$ IN IRRADIATED GLUTARIC ACID. A. Horsfield, J. R. Morton, and D. H. Whiffen (National Physical Lab., Teddington, Middx., Eng.). Mol. Phys., 4: 169-75(Mar. 1961).

It is concluded from electron spin resonance spectra that the radical $(CO_2H)CH_2CH_2\dot{C}H(CO_2H)$ remains trapped in a glutaric acid crystal after γ-irradiation. This radical is found in two different conformations. Approximate hyperfine coupling constants are given for each, although exact interpretation is hindered by the overlapping of spectra. Reasons for the formation of the two forms of the radical are discussed. (auth)

27671 THE EFFECT OF DEUTERIUM AND CHLORINE SUBSTITUTION ON TRIPLET → SINGLET TRANSITION PROBABILITIES IN NAPHTHALENE. M. S. de Groot and J. H. van der Waals (Koninklijke/Shell-Laboratorium, Amsterdam). Mol. Phys., 4: 189-90(Mar. 1961).

The effect of substitution in aromatic molecules on the radiative transition probability from the triplet phosphorescent state (T) to the ground (S_0) state, was measured by irradiating a glassy solution of the phosphorescent substance, at 77°K, in a microwave cavity. The relative concentration of molecules in their triplet state was determined from the (integrated) intensity of the magnetic resonance signal. After the exciting light was switched off the corresponding phosphorescence intensity and decay time were measured by means of a photomultiplier and a recording instrument. Preliminary results on naphthalene, deuteronaphthalene, and β-chloronaphthalene are tabulated. (L.N.N.)

27672 RADIOLYTIC OXIDATION OF FERROUS SOLUTIONS WITH STANDARDIZED INTERNAL SOURCES OF POLONIUM-210. J. Steyn and D. van As (South African Council for Scientific and Industrial Research, Pretoria). Nature, 191: 903-4(Aug. 26, 1961).

The G-value of oxidation in aerated Fricke dosimeter solution for α particles of polonium-210 was redetermined by radiolysis with polonium-210 dissolved in 0.8 N sulfuric acid containing ferrous ammonium sulfate and sodium chloride both at a concentration of 10^{-3} M. The energy dissipated by radioactive decay, and absorbed by the system, was determined from standardization of the specific activity by 4π-internal liquid scintillation counting and an acceptance of the value 5.305 Mev for the energy of the polonium-210 particle. Five irradiations were made yielding a mean G-value of 5.08 ± 0.02 ions per 100 ev. (P.C.H.)

27673 MOLECULAR BASIS FOR ACTION OF IONIZING RADIATIONS. Franklin Hutchinson (Yale Univ., New Haven, Conn.). Science, 134: 533-8(Aug. 25, 1961).

It is hoped that the general picture presented will provide a convenient framework within which to order many of the phenomena treated in radiobiology. The picture incorporates many of the concepts found useful in earlier theories, and also is simple, concrete, and easily visualized. From the theory, a reasonable estimate may be made of the effect of a given dose of radiation on a specific kind of molecule in a cell. Conversely, from the immediate effects produced by a certain dose, some estimate may be made of the mass of intracellular material which must be involved in the processes which are assayed for. It is felt that these advantages will suffice to carry the theory over its many difficulties and deficiencies until another and more encompassing viewpoint can be reached. (P.C.H.)

27674 POLYMERIZATION OF ETHYLENE UNDER PRESSURE BY GAMMA-RAY RADIATION. Yoshinobu Hosaka, Masaaki Takehisa, Yokichi Urano, and Masahiko Yasumoto. Tokyo Kogyo Shikensho Hokoku, 56: 225-32 (June 1961). (In Japanese)

Ethylene was polymerized under pressures between 30 and 100 kg/cm^2 at temperatures between −195 and 100°C, by irradiation with Co^{60} γ rays. The effects of reaction variables on the polymerization of ethylene, and the physical properties of the polyethylenes produced, were studied. The values of $G(-C_2H_4)$ for the polymerization from the purified ethylene were much higher than those for the polymerization from the unpurified ethylene. In the gas phase polymerization of ethylene, the maximum value of $G(-C_2H_4)$ was obtained at a temperature of 40°C. In the liquid phase polymerization, the maximum value was obtained at a tem-

perature of about 7°C, which is near the critical temperature of ethylene (9.9°C). The polymerization was promoted by the addition of organic peroxides, and the value of $G(-C_2H_4)$ was increased. The values of G(polyethylene) obtained were between 1 and 3, regardless of reaction variables. The reaction rate for the polymerization was represented by an apparent first-order rate equation. Polyethylenes produced by γ radiation showed higher melting points and densities than those of the conventional high-pressure polyethylenes. From the data obtained on the density, crystallinity, and infrared absorption spectrum, it is concluded that the polyethylenes obtained are more similar in the physical properties to the Ziegler-type or Phillips-type polyethylenes than to the conventional high-pressure polyethylenes with higher degrees of branching. (auth)

27675 CHEMICAL EFFECTS OF RADIATIVE THERMAL NEUTRON CAPTURE. IX. PHOTOCHEMICAL ANNEALING IN NEUTRON-IRRADIATED PHOSPHATES. R. F. C. Claridge and A. G. Maddock (University Chemical Lab., Cambridge, Eng.). Trans. Faraday Soc., 57: 1392-9(Aug. 1961).

The existence of photo-annealing of the recoil damage in ammonium dihydrogen phosphate using ultra-violet light was previously reported. Further details of these experiments are described. By separating the products formed on solution of the irradiated material, it was possible to show that different recoil fragments are susceptible to annealing either by thermal treatment, ionizing radiations or ultra-violet light. Combined experiments using thermal treatment were employed to show the relationship between the recoil fragments. The effect of using photons of different wavelengths is discussed. (auth)

27676 RADIOCHEMISTRY OF AQUEOUS SOLUTIONS. V. A. Sharpatyi (Karpov Inst. of Physics and Chemistry, [USSR]). Uspekhi Khim., 30: 645-78(May 1961). (In Russian)

The development of radiochemistry of aqueous solutions, the mechanism of radiolytic transformations, and the effects of radiolytic reactions are discussed. 257 references. (R.V.J.)

27677 ANISOTROPY OF HYPERFINE SPLITTING IN ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF IRRADIATED ORIENTED POLYMERS. A. G. Kiselev, M. Y. Mokul'skii, and Yu. S. Lazurkin. Vysokomolekulyarnye Soedineniya, 2: 1678-87(1960).

An attempt was made to identify the radicals formed in irradiated polymers by the hyperfine structure of the EPR spectrum. Experiments were made by stretching oriented polymers. The EPR spectra were taken at various angles between orientation and the magnetic field at 9000 Mc/sec. The investigation covered low-pressure polyethylene stretched in the cold state; polytetrafluoro ethylene (Teflon), stretched at 300°C; polyvinyl chloride stretched at 72°C; and polymethyl methacrylate stretched at 140°C. Irradiation was done either in a reactor (in evacuated quartz ampules at 40–50°C) or by a Au^{198} needle (half-life 64.6 hr). The intensities of the lines and their number depend, in polyethylene, on the angle between elongation axis and magnetic field direction. This result is discussed on the basis of the formation of an alkyl radical which has four equivalent protons and a central H proton. Equations are derived on the basis of the projection of the protons which are not equivalent. Data confirm the formation of an alkyl radical on irradiation at 77°K. Polyethylene irradiated at 40–50°C gave an EPR spectrum with 7 components, each of which was a doublet. This spectrum corresponds to a uniform interaction of an unpaired electron with 6 protons. This is believed to point to the formation of an allyl radical. Anisotropy was also observed in oriented Teflon; the spectra, however, were not analyzed. No anisotropy was observed with polyvinyl chloride and polyamide. The absence of anisotropy in polymethyl methacrylate and polystyrene is explained by the fact that there is no proton in the immediate vicinity of the unpaired electron that might cause, as with polyethylene, an anisotropy of hyperfine splitting. (OTS)

27678 RADIATION OXIDATION OF NITROGEN. VI. SENSITIZATION OF THE PROCESS BY THE CHARGING OF NITROGEN MOLECULES THROUGH IONS OF NOBLE GASES. M. T. Dmitriev and S. Ya. Pshezhetskii (Karpov Inst., Moscow). Zhur. Fiz. Khim., 35: 1010-18(May 1961). (In Russian)

The sensitization by noble gases of the γ-ray induced oxidation of nitrogen was discovered and investigated at pressures 0.1 to 150 atm. The introduction of noble gases into nitrogen or nitrogen–oxygen mixtures accelerates the oxidation by oxygen or water. The sensitizing effect is in the ratio He : Ne : Ar = 1 : 1.16 : 1.40. The value of the coefficient characterizing the efficiency of He, Ne, and Ar was obtained from kinetic data. The mechanism of the sensitizing action apparently consists of an increase in the nitrogen ion concentration due to charge transfer on collision of nitrogen molecules with the ions of the noble gases. (tr-auth)

27679 EPR SPECTRA OF IRRADIATED DICARBOXYLIC ACID. Yu. N. Molin, I. I. Chkheidze, N. Ya. Buben, and V. V. Voevodskii (Inst. of Chemical Physics, Academy of Sciences, USSR and Inst. of Chemical Kinetics and Combustion, Academy of Sciences, USSR). Zhur. Strukt. Khim., 2: 293-300(May-June 1961). (In Russian)

Electron paramagnetic resonance spectra of dicarboxylic acid $[(CH_2)_n(COOH)_2$ with n = 1.2 .., 8] irradiated by 1.6-Mev electrons were investigated at −130°C and room temperature. The EPR spectra of irradiated monocrystals of succinic acid and deuterated succinic acid in carboxylic acid were also analyzed in order to determine the nature of their radicals. Radiation yields of radicals gaseous products of succinic acid radiolysis were determined. The analysis shows that starting with n = 2 the appearance of the EPR spectra does not vary. At −130°C the spectrum consists of a doublet with $\Delta H \approx 26 - 30$e, at room temperature it has two doublets ($\Delta H_1 \approx 40$ e, $\Delta H_2 \approx 70$ to 90 e) and single lines with g = 2.00. The correlation of EPR spectra with gas evolution data indicates radiation disintegration of the carboxylic group. (R.V.J.)

27680 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF ASCORBIC AND DEHYDROASCORBIC ACIDS. Bryan Coleby (to Low Temperature Research Station). British Patent 871,500. June 28, 1961.

A process for the production of L-ascorbic acid and dehydro-L-ascorbic acid and their steroisomers by subjecting an aqueous solution of a gamma-lactone of an aldohexonic acid to ionizing radiation in the absence of oxygen is described. The gamma-lactone is a lactone of L-galactonic, L-gulonic, L-talonic, or L-idonic acid, and the concentration of the lactone is below 0.1M in the solution. Irradiation may be effected by means of x rays, cathode rays (electric beams from electrical generators), or by gamma or beta rays from nuclear disintegrations. The L-ascorbic acid is produced by reduction of dehydro-L-ascorbic acid by the same method. (N.W.R.)

27681 IMPROVEMENTS IN OR RELATING TO GRAFT CO-POLYMERS. Robert Roy Smith, Dennis Charles

MacMillan Mann, and John Frederick Salmon (to B. X. Plastics, Ltd.). British Patent 871,572. June 28, 1961.

A process is described for the manufacture of graft co-polymers (polyethylene) to momomeric vinyl compounds (acrylonitrile) by gamma radiation from a cobalt-60 source. Polyethylene is subjected to the radiation in the presence of oxygen to produce peroxidized active centers on the polyethylene. The peroxidized polymer is treated for at least 100 hrs with an excess of an organic solvent (methylene chloride or acetone) at room temperature. The solvent is insoluble so as to extract the small portion of soluble peroxide material produced on irradiation. The dried solvent-treated polyethylene is then contacted with the acrylonitrile in the vapor phase at a raised temperature of up to 100°C and at sub-atmospheric pressure. A polymerization inhibitor is incorporated in the liquid phase of the grafting material. The polyethylene may be in the form of a film or a powder. (N.W.R.)

27682 IMPROVEMENTS IN AND RELATING TO POLYETHYLENES. (to Union Carbide Corp.). British Patent 871,586. June 28, 1961.

A method is described for upgrading the physical properties of polyethylene by irradiation without impairing its thermoplasticity, moldability, and extrudability while at the same time raising the molecular weight and broadening the range of molecular weight distribution over that of an unirradiated polyethylene. The method consists of exposing the polyethylene pellets, film, or sheet stock to a beta, gamma, or x-radiation dosage ranging from 0.5 megareps up to that dosage which would cause sufficient gelation for mechanically working the polyethylene at a temperature below the fluxing temperature (75°C) and until the gel content is less than one per cent by weight. The radiation dosage is usually between one to ten megareps. The polyethylene is worked in a cooled mixer which is closed to the atmosphere. The mechanically worked polyethylene is heated to an elevated temperature for the addition of dyes, fillers, or antioxidants. (N.W.R.)

27683 PROCESS OF COLD WELDING ORGANOPOLYSILOXANES. (to General Electric Co.). British Patent 871,784. June 28, 1961.

A process for cold welding organopolysiloxanes by placing the sections in intimate contact with each other and treating with high energy radiation until welding is effected is described. The process applies to sections filled with or containing a reinforcing fiber mesh. One section may be filled and the other one not for the welding process. Such a process may be applied in preparing an insulated electrical conductor which comprises wrapping an electrical conductor with an organopolysiloxane (rubber) and welding the turns of the rubber tape to produce a unitary structure. (N.W.R.)

27684 IMPROVEMENTS IN OR RELATING TO MODIFIED SYNTHETIC ADDITION POLYMERS. (to E. I. du Pont de Nemours and Co.). British Patent 875,131. Aug. 16, 1961.

Grafted polymers of superior properties may be prepared by subjecting a synthetic addition polymer substrate to high-energy ionizing radiation and contacting the polymer while it is still in the activated state with one or more polymerizable monomers which contain C—C unsaturation and acid groups. Variants of the method are described. (D.L.C.)

27685 TRANSURANIC ELEMENT, COMPOSITION THEREOF, AND METHODS FOR PRODUCING, SEPARATING AND PURIFYING SAME. Arthur C. Wahl (to U. S. Atomic Energy Commission). U. S. Patent 3,000,697. Sept. 19, 1961.

A process of separating plutonium from fission products contained in an aqueous solution is described. Plutonium, in the tri- or tetravalent state, and the fission products are coprecipitated on lanthanum fluoride, lanthanum oxalate, cerous fluoride, cerous phosphate, ceric iodate, zirconyl phosphate, thorium iodate, or thorium fluoride. The precipitate is dissolved in acid, and the plutonium is oxidized to the hexavalent state. The fission products are selectively precipitated on a carrier of the above group but different from that used for the coprecipitation. The plutonium in the solution, after removal of the fission product precipitate, is reduced to at least the tetravalent state and precipitated on lanthanum fluoride, lanthanum phosphate, lanthanum oxalate, lanthanum hydroxide, cerous fluoride, cerous phosphate, cerous oxalate, cerous hydroxide, ceric iodate, zirconyl phosphate, zirconyl iodate, zirconium hydroxide, thorium fluoride, thorium oxalate, thorium iodate, thorium peroxide, uranium iodate, uranium oxalate, or uranium peroxide, again using a different carrier than that used for the precipitation of the fission products.

Raw Materials and Feed Materials

27686 (K-1271(Del.)) A PILOT PLANT FOR THE REDUCTION OF URANIUM HEXAFLUORIDE TO URANIUM TETRAFLUORIDE WITH TRICHLOROETHYLENE. J. E. Baker, H. V. Klaus, R. A. Schmidt, and S. H. Smiley (Oak Ridge Gaseous Diffusion Plant, Tenn.). May 31, 1956. Decl. with deletions July 26, 1961. Contract W-7405-eng-26. 47p.

Pilot plant experiments are described in which trichloroethylene was used for the reduction of uranium hexafluoride to uranium tetrafluoride. After unsatisfactory preliminary results with liquid phase reduction, satisfactory results were obtained with a vapor phase reduction system. It was found that vapor phase reduction at approximately 450°F, produced a low density product which contained only small quantities of uranium(VI); sintering the uranium tetrafluoride in a hydrogen fluoride atmosphere increased the product density to approximately 3 g/cc. The reduction was essentially complete, and the effluent gas contained less than 1 ppm of uranium hexafluoride. The purity of the uranium tetrafluoride produced was equivalent to that of the uranium hexafluoride used as feed. A complete discussion is given of the operation of the various parts of the system. (auth)

27687 (NP-10438) MONTHLY REPORT [OF] DEVELOPMENT [ON RAW MATERIALS], JUNE 1961. (Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa). 22p.

A discussion is given of atmospheric carbonate leach tests on flotation tails prepared from Beaverlodge mill head samples. Further investigations were conducted of the caustic precipitation of sodium diuranate from pregnant carbonate leach solutions. Crystallization tests were made on representative mill solutions to determine the practical concentration limit for solution volume control of the Beaverlodge process. Results are described of tests in the electrolytic regeneration of sulfuric acid and sodium hydroxide from byproduct sodium sulfate. The effects of digestion temperature on extraction of chemical precipitate feed mixtures of 29% Beaverlodge, 23% Gunnar, and 48% Algom was conducted at 100 to 180°F. Development studies were continued on NRU and NRX production fuel rods. Methods were investigated for the production of uranium

metal powders. Ferrosilicon and magnesium reduction studies of uranium oxides were continued. Ceramic oxide development studies include discussions of: design characteristics of high-temperature controlled atmosphere furnaces; sintering in nitrogen and steam; surface measurements of Port Hope produced ADU and UO_2; conversion of UF_6 to UF_4 in a hot wall reactor; production of fused UO_2; and production of uranium carbides. (B.O.G.)

27688 STUDY OF THE HYDROLYSIS OF URANIUM TETRAFLUORIDE. N. S. Nikolaev and Yu. A. Luk'yanychev. Atomnaya Energ., 11: 67-9(July 1961). (In Russian)

On the basis of electrical resistivity and pH value of the aqueous UF_4 solutions several contradictory formulas were proposed in the literature for the products of the hydrolysis of this material. This question was therefore again studied, taking care to avoid the possibility of oxidation during the measurements. As raw material, UF_4 prepared by the electrolytic reduction of uranyl fluoride resulting from the hydrolysis of UF_6 was used. The hydrolysis of the UF_4 was followed by determining the change of the pH of the solutions at various U concentrations with a precision of 0.02 pH unit. The hydrolysis may be represented by the following reaction: $U^{4+} + nH_2O \rightleftharpoons U(OH)_n^{(4-n)+} + nH^+$ where n (ranging from 1 to 4) is equal to the number of hydroxyl groups on a single U atom in the complex. From the calculated equilibrium constant K_p the instability constants of the hydroxo complexes UOH^{3+}, $U(OH)_2^{2+}$, $U(OH)_3^+$ and $U(OH)_4$ were found to be equal to $4.4 \cdot 10^{-12}$, $2.5 \cdot 10^{-22}$, $2.0 \cdot 10^{-31}$ and $5.7 \cdot 10^{-40}$, respectively. The instability value obtained for $U(OH)^+$ agrees within an order of magnitude with the value reported by K. Kraus and F. Nelson (J. Am. Chem. Soc. 72, p.3901 (1950) and 77, p.3721 (1955)). (TTT)

27689 SOME PREPARATIVE METHODS AND PHYSICAL CHARACTERISTICS OF URANIUM DIOXIDE POWDERS. J. C. Clayton and Seymour Aronson (Westinghouse Electric Corp., Pittsburgh). J. Chem. Eng. Data, 6: 43-51 (Jan. 1961). (WAPD-T-688)

Previous results on the dependence of UO_2 properties upon their mode of preparation are confirmed and their conclusions extended to UO_2 powders made by a large variety of oxidation and reduction methods. Low temperature preparations (350°C) produced the smallest crystallite sizes (200 A); the crystallite size of UO_2 made at 800°C was considerably larger (1000 A). The real density of UO_2 preparation depends upon its O to U ratio and on the density of its parent higher oxide. The density was not dependent on reduction temperature up to 1200°C. However, heating low density UO_2 above its temperature of preparation causes an increase in density. In many cases the liquid displacement densities were considerably below the helium displacement values, indicating measurable amounts of open porosity. No correlation was found between density and total BET surface area. There also appears to be no relationship between the density and total surface area of the parent ammonium diuranate precipitates and the derivative UO_2 powders. The particle size distribution and total BET surface area of a UO_2 preparation depend upon the particle size distribution and surface area of the higher oxide from which it was prepared by reduction and on the reduction temperature itself. In the reduction of UO_3, the uranium dioxide reduction product was most similar in surface area and particle size distribution to the parent oxide at low temperatures (480°C). Particle growth occurred at higher temperatures. No change in particle size distribution, but an increase in surface area was observed on low temperature reduction (500°C) of U_3O_8 to UO_2. There was less particle breakdown at higher reduction temperatures. This suggests that fracturing occurs in the U_3O_8 particles on reduction to UO_2 at the lower temperature; at higher temperatures, the strains are annealed out. (P.C.H.)

27690 KINETICS OF THE REDUCTION OF U_4O_9 IN HYDROGEN. S. Aronson and J. C. Clayton (Westinghouse Electric Corp., Pittsburgh). J. Inorg. Nuclear Chem., 7: 384-91(1958). (WAPD-T-736)

The reduction of U_4O_9 powders in hydrogen was studied at temperatures of 400-600°C and at hydrogen pressures of 20-500 mm Hg. Under these conditions U_4O_9 is reduced to $UO_{2.02\pm0.02}$. X-ray diffraction studies showed that during reduction U_4O_9 is converted into the fluorite structure of uranium dioxide. X-ray data on U_4O_9 samples reduced at 470°C indicate that the initial reduction product is non-stoichiometric UO_{2+x} ($0.10 > x > 0.06$). The rate data were analyzed on the assumption that the reaction rate is controlled at the solid–gas interface, such as the particle surface. Rate constants and activation energies were calculated. The rate constant k fits an empirical expression of the form $k = Kf(p)e^{-E/RT}$, where E is the activation energy, $f(p)$ is an undetermined function of pressure, and K is a proportionality constant. The term $f(p)$ is approximately equal to $p^{0.1}$; however, the pressure dependence decreases with increasing pressure. A possible mechanism for the surface reaction is discussed. The calculated activation energy for the reduction of U_4O_9 is 25 ± 3 kcal/mole. (auth)

27691 A URANIUM ORE FLOTATION PILOT PLANT. Brad Gunn, R. I. Eager, and A. B. Van Cleane [Univ. of Saskatchewan, Saskatoon]. Precambrian, 34: No. 7, 8-11 (July 1961).

A flotation pilot plant capable of handling 50 to 100 lb/hr of pegmatitic uranium ore on a continuous basis was assembled at the University of Saskatchewan in Canada. Preliminary results are satisfactory enough to warrant consideration of a flotation process for the recovery of uranium from some pegmatitic ores. The flotation circuit is discussed, and a flow sheet of the pilot plant is diagrammed. Some test results are also given. (P.C.H.)

27692 IMPROVEMENTS IN OR RELATING TO PRODUCTION OF URANIUM AND ITS COMPOUNDS. John Erskine Mann, Ralph Eric Worthington, and Keith David Bebb Johnson (to United Kingdom Atomic Energy Authority). British Patent 874,904. Aug. 16, 1961.

A process is outlined for producing U or its compounds enriched in U^{235} with less production of UF_6 than in previous processes and avoidance of UF_6 conversion to UF_4. The process comprises reacting enriched UF_6 with UF_6 in a fluidized bed to form enriched UF_5, heating the UF_5 to ~400°C to cause disproportionation to UF_6 and enriched UF_4, and recycling the UF_6 for re-enrichment. The enriched UF_4 may be treated for conversion to metal. Flowsheets are presented for the process. (D.L.C.)

Separation Processes

27693 (HW-38210) REDOX PLANT SHUTDOWN REPORT–JUNE 13 TO JUNE 25, 1955. R. T. Jessen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 20, 1955. Decl. July 17, 1961. 5p.

A summary is presented of the accomplishments during the plant shutdown, which were directed toward: crane decontamination and repair; canyon equipment changes; maintenance work outside the canyon; and flushing the head-end, columns, and the plutonium vessels. Discussions are given of the difficulties encountered during the shutdown, and the improvements resulting from the shutdown. (B.O.G.)

27694 (HW-70199) USE TEST COMPARISON OF TBP DILUENTS. John E. Mendel (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 6, 1961. Contract W-31-109-Eng-52. 10p.

Several diluents for possible use in TBP Purex Plant solvent were tested. The tests included nitric–nitrous acid degradation, fission product distribution under simulated plant conditions, emulsification, and radiolysis. The order of quality of four diluents is n-dodecane > Soltrol 170 > Shell Code 85030(82000) > Shell E-2342. (D.L.C.)

27695 (IA-619) FOCUSING ELECTROPHORESIS. D. Maydan, J. Toicher, and Z. Zeidenberg (Israel. Atomic Energy Commission, Tel-Aviv). July 1961. 12p.

The separation of the groups of cations Cu–Co–Ni, Ca–Sr–Y, Ce–Pr–Pm–Tb–Tm, and Zr–Nb was investigated using focusing electrophoresis, a rapid radiochemical separation method developed by Schumacher. The separation of Ca–Sr–Y was achieved; the problems that occurred in the separation of other groups are also discussed. (auth)

27696 (IS-309) A SMALL SCALE COUNTERCURRENT LIQUID-LIQUID EXTRACTOR. Harley A. Wilhelm (Ames Lab. Ames, Iowa). June 1961. Contract W-7405-eng-82. 33p.

Details of design and operation are given for a laboratory-size, 20-stage, multiple-contact, "unlimited-feed", countercurrent-flow, liquid-liquid extractor. The apparatus consists mainly of glass parts that are joined by polyethylene tubing and are mounted in a steel cradle that can rotate on its horizontal axis. The reservoirs for feed liquids are an integral part of the assembly, and proper rotation of the assembly causes the flow of liquids to, through and from the extractor. Testing and developing of, and small scale production by, extraction systems are conveniently carried out in this extractor. Stagewise and product samples can be readily obtained for study of the extraction behavior of the components of a liquid-liquid system. (auth)

27697 (NYO-9200) THE ADAPTATION OF NEW RESEARCH TECHNIQUES TO MINERAL ENGINEERING PROBLEMS. A Semi-Annual Progress Report for the Six-Month Period Ending April 30, 1961. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-956. (MITS-46). 58p.

Adsorption of Amine on Silver Iodide. Adsorption isotherms were measured on silver iodide precipitates for potential-determining ions in the presence of dodecylammonium nitrate (DAN) and of DAN as a function of silver concentration. Hematite–Aqueous Solution–Organic Liquid System. Solubility determinations of various alkyl sulfonates in organic liquids were made, and the distribution of dodecyl sulfonic acid and hexadecyl sulfonic acid between water and diisobutyl ketone was measured as a function of the pH of the aqueous solution. The specific conductance of aqueous solutions of hexadecyl sulfonic acid and its sodium salt was also measured as a function of concentration, and the solubility of the sodium salt was determined. Preliminary adsorption tests were carried out with hematites and dilute aqueous solution of hexadecyl sulfonic acid. Hysteresis of Contact Angles. Studies of contact angles in the mercury–water–benzene system are reported along with preliminary work on the benzene–water-quartz and water–nitrogen-paraffin systems. Dissolution of Zinc Sulfide in Acid Media. The leaching of zinc sulfide by sulfuric acid was studied to determine the effects on the reaction of hydrogen peroxide addition, agitation, surface area of the zinc sulfide, initial sulfuric acid concentration, temperature, and initial Z_n^{2+} concentration in the leach solution. Influence of Iodine on the Flotation of Sulfide Minerals. The results of experiments on the recovery of sulfide minerals by iodine in flotation cells are summarized. Radioisotopes for Coarse Ore Concentration. Adsorption studies on chalcocite-containing ore pieces were conducted using a solution of $Cu^{64}SO_4$. It was found that the activity of the ore pieces, due to exchange of the Cu atoms with Cu^{64}, is dependent on the pH and that using Cu^{64} to obtain a difference in activity level between ore pieces of differing Cu content is feasible. Brittle Fracture. Preliminary results are described for experiments on the size distribution of fragments from breakage by a ballistic missile. Particle Size Determination. A centrifuge operating at 500 to 1000 g for resolving fine materials is described. Thickening Mechanism. Results are reported for experiments conducted to correlate the rate of passage of flocculated $CaCO_3$ through a narrow opening with sedimentation volume and additions of stearic acid (in benzene solvent) and of thapsic acid (in methyl alcohol solvent). (D.L.C.)

27698 (ORNL-3106) SOLVENT EXTRACTION OF URANIUM FROM CARBONATE SOLUTIONS. F. G. Seeley, F. J. Hurst, and D. J. Crouse (Oak Ridge National Lab., Tenn.). Aug. 30, 1961. Contract W-7405-eng-26. 43p.

A process for recovering uranium from carbonate leach liquors by extraction with quaternary ammonium compounds was developed and evaluated in bench-scale continuous equipment with synthetic liquors. Uranium was recovered from the solvent by direct precipitation with sodium hydroxide–sodium carbonate solution. Results with relatively pure synthetic carbonate liquors were favorable, but attempts to treat a highly contaminated leach liquor from a western mill were relatively unsuccessful owing to interference from sulfate, chloride, thiocyanate, molybdenum, vanadium, and organic matter present. The process is therefore not considered competitive with the precipitation process used in several western carbonate-leach mills. (auth)

27699 (ORNL-3143) MISCELLANEOUS EXPERIMENTS RELATING TO THE PROCESSING OF CETR FUEL BY SULFEX-THOREX AND DAREX-THOREX PROCESSES. L. M. Ferris and A. H. Kibbey (Oak Ridge National Lab., Tenn.). Aug. 30, 1961. Contract W-7405-eng-26. 19p.

Experiments with unirradiated Consolidated Edison reactor ThO_2–UO_2 fuel pellets indicated that uranium losses to Sulfex and Darex decladding solutions were proportional to the UO_2 content of the pellets. For example, after 7 hr, losses to boiling initial Darex solution (5 M HNO_3–2 M HCl) were 0.45 and 0.65% from pellets containing 3 and 9% UO_2, respectively. The initial rate of dissolution of these pellets in 200% excess boiling 13 M HNO_3–0.04 M NaF–0.1 M $Al(NO_3)_3$ was essentially independent of the UO_2 content. Rates were 2.1, 3.0, and 2.4 mg min^{-1} cm^{-2} for pellets containing 3, 6, and 9% UO_2, respectively. The presence in the dissolvent of the soluble neutron poisons H_3BO_3 and $Cd(NO_3)_2$ in concentrations up to 0.1 M and 0.075 M, respectively, had little effect on the rate of dissolution of sintered UO_2–ThO_2 fuel pellets. (auth)

27700 (ORO-144(Del.)) A REPORT OF THE POWER REACTOR FUEL PROCESSING SYMPOSIUM HELD JULY 12-13, 1955 AT OAK RIDGE NATIONAL LABORATORY. (Oak Ridge Operations Office. Research and Development Div., AEC). Oct. 1955. Decl. with deletions June 5, 1961. 270p.

A collection of the papers presented at the Introductory Symposium on Power Reactor Fuel Processing is given. A substantial introduction to the present reactor fuel proc-

essing technology is presented, including descriptions of existing processing facilities at Idaho Falls and Oak Ridge and a look at future processing techniques now under development for accommodating the newer, more difficult to process fuel elements. Twenty papers are included. (M.C.G.)

27701 USE OF ION-EXCHANGE MEMBRANES IN HYDROMETALLURGY OF URANIUM. B. N. Laskorin and N. M. Smirnova. Atomnaya Energ., 10: 353-61(Apr. 1961). (In Russian)

It is shown that electrodialysis with ion exchange membranes can be applied for reducing saturation acidity and neutralizing sulfuric, nitric, and hydrochloric acid solutions. Also, the method is used for eliminating sodium ions from uranium carbonate solutions. (tr-auth)

27702 STUDY OF INDUSTRIAL ION EXCHANGE SEPARATION OF RARE EARTH ELEMENTS BY EDTA COPPER METHOD. 3. MANUFACTURE OF ION EXCHANGE EQUIPMENT. Kenjiro Nishigori, Toyoji Ishiyama, and Tadashi Kuroda. Denki Shikensho Iho, 25: 327-36(Mar. 1961). (In Japanese).

Ion exchange equipment was manufactured for trial. The equipment has five ion exchange towers, and the total capacity is 100 liters of strong acid type ion exchange resin. The equipment purifies 2.2 kg of rare earth into an oxide. In the case of refining of 2.2 kg of cerium oxide, 79% in purity, 1.37 kg of pure cerium is obtained by using the EDTA copper method. (Abstr. Bull. Electrotech. Lab. (Tokyo) 25; No. 5, 1961)

27703 THE SEPARATION OF INDIUM AND TIN BY ALKYLPHOSPHORIC ACIDS. I. S. Levin and V. A. Mikhailov (Inst. of Chemistry and Metallurgy and Inst. of Inorganic Chemistry, Siberian Branch, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 1392-4(June 21, 1961). (In Russian)

A mixture of isoamylphosphoric and isoamylpyrophosphoric acids was obtained by reacting isoamyl alcohol with P_2O_5. A 20 vol. % solution of this extractant in benzene or toluene was used to develop a simple, effective method of separating indium from tin. The tracers In^{114} and $Sn^{113,123}$ were used to follow the course of the extraction. It was found that indium extracts with a very high distribution coefficient from even 10 N H_2SO_4 and higher, while divalent tin remains almost quantitatively in the aqueous phase. The separation coefficient is 10^6 during the extraction. The indium can be back-extracted with a small amount of 6 to 9 N HCl with a 10- to 20-fold concentration of indium. The method gives sharp separations even when the ratio of Sn to In is varied from 10:1 to 10:5000. Tetravalent tin can be removed by washing with an HF solution. Analogous results were obtained with di-(2-ethyl) hexyl phosphoric acid. The method can be employed as an analytical method or as an industrial process. (TTT)

27704 STUDIES ON COUNTERCURRENT EXTRACTION OF RADIONUCLIDES. II. SEPARATION OF ^{233}U AND ^{233}Pa FROM IRRADIATED THORIUM TBPO–HCl SYSTEM. Tomitaro Ishimori (Japan Atomic Energy Research Inst., Tokyo) and Hassan M. Sammour. J. At. Energy Soc. Japan, 3: 410-15(June 1961). (In English)

Solvent extraction of U^{233} and Pa^{233} from irradiated thorium was carried out by the discontinuous countercurrent extraction technique in hydrochloric acid solutions of various concentrations with tri-n-butyl phosphine oxide (TBPO). The results showed that 1 N HCl with 1% TBPO-toluene solution is the best medium to effect such separation. A higher decontamination factor for uranium fraction, and clean separation of protactinium from thorium were obtained under these conditions. (auth)

27705 LABORATORY DEVELOPMENT OF THE ACID THOREX PROCESS FOR RECOVERY OF THORIUM REACTOR FUEL. R. H. Rainey and J. G. Moore (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 10: 367-71 (Aug. 1961).

The Acid Thorex process is developed on a laboratory scale for recovery of uranium and thorium from spent fuel solutions. The thorium and uranium are extracted by tributyl phosphate (TBP) with only the thorium nitrate and nitric acid as "salting agents." As compared to the Thorex process in which aluminum nitrate is employed as a salting agent, a considerable reduction in aqueous waste volumes is possible. With a synthetic solution of Consolidated Edison Thorium Reactor fuel as feed, uranium and thorium are separated from ruthenium, zirconium–niobium, protactinium, and rare earth elements by factors of 2000, 30,000, 1000, and 10^5, respectively. The concentrated aqueous waste volume is 0.2 liter per kilogram of thorium processed. These values compare favorably with corresponding separation factor values for the aluminum-salted Thorex system of 600, 3000, 3000, and 2×10^5 and a corresponding volume of 2 liters per kilogram of thorium processed. (auth)

27706 ADSORPTION OF PLUTONIUM COMPLEXES IN ORGANIC MEDIA ON THE METALLIC SURFACE. Mieczysław Taube (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 371-7 (1961). (In English)

The adsorption of some organic complexes of plutonium (IV) with dodecylphosphoric acid, dibutylphosphoric acid, tri-n-butylphosphate, tri-n-octylamine and tetrabutylammonium nitrate on a Pt surface in organic media of low dielectric constant (carbon tetrachloride, benzene, chloroform) was investigated. It was found that the plutonium adsorption depended on the concentration and chemical properties of the complexing agent, on the initial concentration of nitric acid, and also on the properties of the diluent. (auth)

27707 SEPARATION OF HAFNIUM FROM ZIRCONIUM BY EXTRACTION WITH TRIBUTYL PHOSPHATE (II). T. Patzek. Prace Inst. Hutniczych, 13: 73-6(1961). (In Polish)

A simple process is described for producing hafnia-free zirconia by extraction with a solvent containing 60% vol tributyl phosphate and 40% mepasine. A twelve-stage mixer-settler battery and a feed solution containing 80 g ZrO_2/l were used. Feed and scrub solutions did not contain any additional salting out components such as sodium nitrate, and the solvent was not acidified separately before recycling. A possibility of reducing the number of stages in the extraction unit is observed. The use of very highly concentrated feed solutions does not seem to be advantageous. (auth)

27708 SOLVENT EXTRACTION STUDIES. PART 4. VISCOSITY MEASUREMENTS ON THE SYSTEM NITRIC ACID + TRI-n-BUTYL PHOSPHATE. D. G. Tuck (Univ. of Manchester, Eng.). Trans. Faraday Soc., 57: 1297-1304(Aug. 1961).

Viscosity measurements were made on mixtures of tri-n-butyl phosphate (TBP) and water, TBP and anhydrous HNO_3, and on extract solutions of nitric acid in TBP. The results are discussed in terms of the interactions between like and unlike molecules. Since the species involved have similar molar volumes, it is possible to derive values for

the excess free energy of mixing at different mole fractions. In general, the results agree with previous work on the TBP + H_2O + HNO_3 system. (auth)

27709 SOLVENT EXTRACTION OF THORIUM FROM SULFOCATIONITES. E. I. Kazantsev and V. N. Perevozov (Kirov Ural Polytechnic Inst., USSR). Zhur. Priklad. Khim., 34: 1448-56(July 1961). (In Russian)

Experiments show the following order of capacities for extraction of Th from sulfocationites: $C_6H_7O_7(NH_4)_2$ > $(NH_4)_2C_2O_4$ > CH_3COONH_4 > $(NH_4)_2SO_4$ > NH_4NO_3 for salt solutions and H_2SO_4 > HNO_3 > HCl for acid solutions. The best and fastest results were obtained with 2 to 4 N sulfuric acid solution. (R.V.J.)

27710 IMPROVEMENTS IN OR RELATING TO THE CONTACTING AND SUBSEQUENT SEPARATION OF TWO IMMISCIBLE LIQUIDS. Douglas Bradley (to United Kingdom Atomic Energy Authority). British Patent 874,017. Aug. 2, 1961.

A multi-stage liquid-liquid extraction process is described for contacting and subsequently separating two immiscible liquids. The process consists of feeding the liquids separately to the inlet of a first hydraulic cyclone having overflow and underflow outlets with one outlet relatively large compared with the other outlet. One of the liquids is withdrawn substantially free from the other liquid at the small outlet of the first cyclone and the remaining mixture is withdrawn from the large outlet. The remaining mixture is fed to the inlet of a second cyclone having overflow and underflow outlets in inverse size relation to those of the first cyclone. The other liquid is withdrawn substantially free from the first-mentioned liquid at the relatively small outlet of the second cyclone. The liquid left in the second cyclone is recycled from the large outlet to the inlet of the first cyclone. (N.W.R.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

27711 (BM-RI-5832) CONSTRUCTION, CALIBRATION, AND OPERATION OF ICE CALORIMETERS. Donald F. Smith, Charles E. Kaylor, George E. Walden, Arthur R. Taylor, Jr., and John B. Gayle (Bureau of Mines. Tuscaloosa Metallurgy Research Center, Ala.). Nov. 1960. 20p.

The construction and calibration of two ice calorimeters are described. The results of high-temperature heat-content measurements made on RbF, HfF_4, CsCl, and CsI are included. The heats and entropies of fusion of RbF, CsCl, and CsI were calculated at their respective melting points using equations derived from the experimental heat-content data. Hafnium tetrafluoride did not melt within the range of temperature investigated. Heat and entropy of transition of the CsCl from the alpha to the beta phase were also determined. (auth)

27712 (HW-63455) FINAL REPORT OF PIPING COMPONENTS FOR ORGANIC COOLANTS. Howard L. Floyd (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 12, 1960. Contract AT(45-1)-1350. 5p.

The Mechanical Organic Test System, Number One (MOTS-1) was fabricated and operated to 325 psi, and 350°C. The re-circulation pump provided 43 gallons per minute flow. Total operation of the system was 6200 hours with five organic liquids used for coolants. Monoisopropylbiphenyl and a tertiary eutectic were reported previously. Three others of similar composition were studied. Monoisopropylbiphenyl exhibited the most desirable mechanical characteristics. Four mechanical seals were fitted with rigid mounts, precision bearings, and liquid cooling. The seals ran satisfactorily for about 2000 hours, each. Screwed fittings and flanges exposed to continuous thermal cycling showed evidence of leaking. Disassembly and inspection revealed no corrosion, but the system was lined with a black residue that showed a tendency to settle out in points of low flow and temperatures. Results are tabulated. (auth)

27713 (HW-66864(Rev.)) TECHNICAL SPECIFICATIONS FOR SOLVENT EXTRACTION COLUMNS IN THE NEW PLUTONIUM RECLAMATION FACILITY—CAC-880. L. E. Bruns (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 26, 1961. 7p.

27714 (HW-68636) AIR PULSER FOR H-1 COLUMN. L. E. Bruns (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1, 1961. 8p.

A discussion and diagrams are given of an air pulser system for the H-1 Recuplex solvent extraction column. The diagrams show the hood and piping required in the duct level between the new hood and the solvent extraction hood, and the solvent extraction hood piping and a possible arrangement of the panel board for the Recuplex operating level. (B.O.G.)

27715 (NP-10362) CABEZAL AUTOMÁTICO PARA TRASLADO DE MUESTRAS IRRADIADAS. Informe No. 40. (Device for Automatic Transfer of Irradiated Samples. Report No. 40). Erico Spinadel (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). 1960. 15p.

A device for moving irradiated samples, samples to be irradiated, or radioactive materials from storage to the irradiation facility or vice versa is described. The apparatus, a sketch of which is given, is operated electrically by remote control. (J.S.R.)

27716 (NYO-9321) INVESTIGATION OF TYPES OF SEALS FOR MAIN COOLANT PUMPS FOR LARGE PRESSURIZED WATER REACTOR NUCLEAR PLANTS. (Ebasco Services, Inc., New York). June 1960. Contract AT(30-1)-2547. 83p.

Results of a study concerned with canned-motor and controlled-leakage pumps are presented for large pressurized water reactor power plants. The general aim of the study is to determine the comparative reliability and installed operating cost of canned-motor and controlled-leakage pump designs. The current research and development programs are also evaluated. Installation and operational costs are projected for 1968 activity. (J.R.D.)

27717 (SCDR-27-61) QUANTITIVE DETERMINATION OF RESIDUAL LEAK-DETECTION TRACER GAS USING A STANDARD LEAK DETECTOR. J. P. Darginis (Sandia Corp., Albuquerque, N. Mex.). July 1961. 11p.

A method is outlined for monitoring and computing helium outgassing rates at storage sites by using the standard leak detector. An alternative approach obviates the use of leak testing equipment because a minimal amount of helium would enter the unit. In this method, the container would be placed into a pressure chamber and the amount of tracer gas leaking into the unit would be measured. (auth)

27718 (SCR-409) OUTPUT MEAN AND DEVIATION VERSUS INPUT S/N FOR LINEAR, QUADRATIC, AND QUANTIZING ENVELOPE DETECTORS WITH SATURATION. Charles S. Williams, Jr. (Sandia Corp., Albuquerque, N. Mex.). May 1961. 38p.

The output voltage of the three detectors considered depends at any instant on the envelope of the rf input voltage at the same instant in the following manner: the output may be proportional to the envelope below saturation input, and constant for all higher inputs; it may be proportional to the square of the envelope below saturation input, and constant for all higher inputs; or it may be zero when the envelope is below a quantizing threshold, and a positive constant for all higher inputs. The rf input voltage is the sum of the desired rf signal voltage (which may be pulsed) of power S, and a rf interference voltage of power N. The d-c component and the rms value of the a-c component of the output voltage are charted as functions of the rf signal-to-noise ratio S/N for four types of rf interference and for the cases where the saturation (or quantized level) of the output is 2, 3, 4, 5 and 10 times the dc component of the output due to the interference alone. (auth)

27719 (CEA-tr-R-1341) GÉNÉRATEUR DE NEUTRONS À BASE DE POLONIUM–BÉRYLLIUM. (A Polonium–Beryllium Neutron Generator). O. D. Belomar. Translated into French from Russian Patent No. 12 77 65, 1960. 6p.

A neutron source, different from previous sources in that it provides a neutron flux of controllable intensity and the ability to stop the flux, is described. It consists of two sets of foils placed in a container under vacuum. The first set is fixed and the surfaces are covered with polonium or one of its compounds. The second set is mobile and the surfaces are covered with beryllium or one of its compounds. In operation, the mobile set of foils comes between the fixed set. The mobile system is operated by a spring on the side and the forces of a magnetic field on the other. (J.S.R.)

27720 CLOSED CIRCUIT T.V.–NUCLEAR REACTOR MAINTENANCE TOOL. George W. Fieser and Vincent W.

Minkle (Allis-Chalmers Mfg. Co., Washington, D. C.). Atomics, 14: 13-15(July 1961).

A remote-control closed-circuit television system is described that is to be used in the EGCR. The system consists of two independently-operated cameras, having 30 in. lengths and 3.75 in. diameters. One of the cameras is used to observe the upper sections of the reactor plenum, and the camera inserted into the fuel channels. The system has 17-in. monitor screens. (T.F.H.)

27721 POWER LOSS AND INITIAL SHAFT TORQUE IN SEALS OF FROZEN SODIUM. A. V. Drobyshev and N. M. Turchin. Atomnaya Energ., 10: 386-7(Apr. 1961). (In Russian)

The friction power loss of frozen sodium seals was analyzed as a function of the number of shaft rotations. The power loss in frozen sodium seals is 0.7 to 1% of the power used in sodium pumping. The rate of sodium loss is 2 to 3 cm^3/day. Considering laminar flow and pressure, the evaluated liquid sodium film is 15 to 20μ. The temperature distribution at a condensation point at various cooling temperatures is plotted as well as the tangential intensity τ of the initial shaft rotation moment as function of temperature. (R.V.J.)

27722 A UNIVERSAL GAMMA-RAY UNIT FOR USE IN RADIATION CHEMISTRY. N. G. Alekseev, K. N. Emel'yanov, G. K. Klimenko, B. V. Rybakov, and A. A. Rostovtsev Atomnaya Energ., 10: 396-400(Apr. 1961). (In Russian)

Descriptions are given of an installation for radiochemical studies. The facility allows irradiation to 500 r/sec at remotely-controlled high or low temperatures. The cylindrical emitter consists of 24 Co^{60} sources 160 mm high with a total activity of 5000 g/equiv Ra. (R.V.J.)

27723 NEW UNIVERSAL CHAMBER FOR α, β, AND γ-ACTIVE MATERIALS. G. N. Lokhanin and V. I. Sinitsyn. Atomnaya Energ., 10: 420-1(Apr. 1961). (In Russian)

Descriptions are given of a new chamber operating with α, β, or γ sources up to 50 mg equiv Ra. The chamber dimensions are 2970 × 2560 × 2360 mm, and the total weight is 5700 kg. The biologically shielded chamber will withstand elevated temperatures, humidity, and acid and alkali media. (R.V.J.)

27724 SURFACE COVERINGS OF STRUCTURAL COMPONENTS IN RADIOACTIVE LOCATIONS. A. N. Komarovskii. Atomnaya Energ., 10: 597-605(June 1961). (In Russian)

A surface coating should be stable to radiation, corrosive liquids and gases and thermal effects, should be easily decontaminated, should possess mechanical strength and resistance to wear, and should show a minimum amount of induced radioactivity due to neutron interaction. Although stainless steel sheet 2 to 3 mm thick has been extensively used to cover the floors, walls and ceilings of radioactive cells, a special polychlorovinyl mastic 57-40 has been developed and extensively applied in order to replace the more expensive stainless steel covering. The 57-40 mastic is cheaper and more easily decontaminated than steel or stainless steel coverings. The more expensive stainless steels such as 1Cr18Ni9T, Cr18Ni12M2T and Cr18Ni12M3T are still used in corrosive media at temperatures of 400°C and higher. The mastic, which is made in the form of sheet, is operationally stable for long periods of time in high-level radiation fields. At first, it loses 40 to 50% of its initial desirable mechanical properties such as resistance to tearing and ductility on long exposure to radiation. Then, with further irradiation, additional polymerization takes place, and it regains its initial mechanical properties. The material can readily be butt-welded or lap-welded by a high-frequency electrical current, or by means of special hot air welding torches. The 57-40 polyvinylchloride plastic is stable to 35% HCl (up to 70°C), 90% H_2SO_4 (up to 40°C), 35% HNO_3 (up to 20°C), a mixture of dilute H_2SO_4 and HNO_3 (up to 65°C), 40% NaOH (up to 60°C), 32% silicofluoric acid (up to 60°C), 100% acetic acid (up to 40°C), 35% chromic acid (up to 60°C), 84% H_2O_2 (up to 20°C) and 100% H_3PO_4 (up to 60°C). The plastic sheet is secured to the wall with special fasteners shot into the wall, and supported on the wall with metal strips which are then covered with plastic. Glue is not used extensively to secure the plastic sheets in view of the thermal and radiation instability of the glue. (TTT)

27725 DE-ENTRAINMENT IN EVAPORATORS. Carl S. Schlea and John P. Walsh (E. I. du Pont de Nemours & Co., Inc., Aiken, S. C.). Ind. Eng. Chem., 53: 695-8(Sept. 1961).

The design, principles, and success of an impingement cap de-entrainer are discussed. The impingement cap, which was found to be a better de-entrainer than the bubble cap, utilizes a higher impaction velocity and smaller impingement clearances. The principles of impingement by impaction of vapor jets on flat surfaces were used to design the impingement cap. With two caps in series, entrainment was reduced to about one-fourth pound of liquid per million pounds of vapor. The effectiveness of the de-entrainers studied is summarized, and illustrations of the design are given. (P.C.H.)

27726 IMPROVEMENTS IN OR RELATING TO TANKS FOR HOLDING A COOLANT TO BE CIRCULATED THROUGH A NUCLEAR REACTOR. Everett Long and Ronald Scott Challender (to United Kingdom Atomic Energy Authority). British Patent 874,091. Aug. 2, 1961.

A tank, mounted above a reactor and forming the top cover for the vessel containing the reactor, for accommodating the coolant of a reactor is described. The tank is divided into upper and lower compartments by a horizontal, heat insulated diaphragm. The lower compartment is divided by a vertical diaphragm into a center core part and an outer annular part. There is a pump supported in the tank. A heat exchanger supported in the tank provides heat exchange in the flow of fluid between the compartments. There are tubular stays passing vertically through the tank with a support grid between them. (N.W.R.)

27727 A REMOTELY-CONTROLLED MANIPULATOR. (to Vyzkumny a Zkusebni Letecky Ustav). British Patent 874,104. Aug. 2, 1961.

A remote-control manipulator for handling contaminated material is described. The manipulator consists of a handle mounted in universal suspension on a housing at one end of a supporting tube, wherein the supporting tube is mounted in and passes through a ball joint, which is carried in a protective wall of a contaminated space. The handle and the operating member are disposed without and within the space respectively. The handle carries a plate which is in contact with at least three pins, slidably mounted in the housing. The pins are in pressure contact through hydraulic means with the same number of additional pins which are slidably mounted in an additional housing and which are in contact with an additional plate carried by an operating member mounted in universal suspension on the additional housing at the other end of the supporting tube. The pins are formed as continuous rods with each end of the rods being in contact with one of the plates. The operating member carries a chuck jaw for manipulating purposes. (N.W.R.)

27728 IMPROVEMENTS IN OR RELATING TO CHUTES, FOR EXAMPLE, CHUTES FOR FUELING NUCLEAR REACTORS. Ronald Bellinger and Ernest James Hutchinson (to Strachan & Henshaw, Ltd.). British Patent 874,222. Aug. 2, 1961.

A chute for loading fuel elements into a selected reactor channel is described. The chute consists of a tube, a thrust support at the foot of the tube, means for turning the tube around its axis, a laterally displaceable lower portion supported on the tube, and means for effecting lateral displacement. The chute is provided with a coaxial sleeve turnably mounted thereon and coupling means are provided between the sleeve and the laterally displaceable lower portion, such that lateral displacement is effected by rotating the sleeve on the chute. The chute and sleeve are provided with engaging and disengaging means for engaging the actuating members in the lower position and disengaging the chute for removal and raising. The laterally displaceable portion is arranged for parallel movement and is vertically disposed at all times. (N.W.R.)

27729 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR POSITIONING AN ADJUSTABLE CHUTE SUCH AS A FUEL ELEMENT CHARGE CHUTE FOR A NUCLEAR REACTOR. Ronald Bellinger (to Strachan & Henshaw, Ltd.). British Patent 874,223. Aug. 2, 1961.

A chute headbox or positioner, having an adjustable chute, is described for loading a reactor. The headbox is designed for turning and radiusing a chute of the kind having a sleeve rotatably mounted on the chute head and a movable chute part mounted on the chute and coupled to the sleeve for radiusing movement of the chute part laterally relative to the chute. Means are included for receiving the head of the chute. Coupling means are provided for coupling the engaging means to the chute head. A rotatable driving member is mounted in the headbox. Coupling means are provided for coupling the rotatable driving member to the sleeve. Driving means are provided for rotating the engaging means and the rotatable driving member independently. The rotatable driving member may consist of a second sleeve which is coupled with the first sleeve and an indicator. (N.W.R.)

27730 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR HANDLING RADIO ACTIVE MATERIALS FOR USE IN CHARGING AND/OR DISCHARGING A VESSEL SUCH AS THE PRESSURE VESSEL OF A NUCLEAR REACTOR. Ronald Bellinger, Ernest James Hutchinson, and William Henry Shipley (to Strachan & Henshaw, Ltd.). British Patent 874,225. Aug. 2, 1961.

An apparatus is described for handling radioactive materials in charging and/or discharging a reactor. The apparatus includes a chamber having an outlet adapted to be detachably connected to an inlet of the vessel, storage means in the chamber for charge material to be charged into or discharged from the vessel, grab and hoist means within the chamber for handling the charge material, and control means outside the chamber for controlling the grab and hoist. A charge guiding chute is included in the chamber for introducing the material. (N.W.R.)

27731 IMPROVEMENT IN OR RELATING TO TURBINE-DRIVEN STIRRERS. Stanley Rennoldson and Newton Dodsworth (to United Kingdom Atomic Energy Authority). British Patent 875,080. Aug. 16, 1961.

A turbine stirrer powered by compressed air is designed for use with radioactive liquids in a glove box. The stirrer has a turbine casing provided with inlet and outlet pipes coupled with flexible pipes which lead outside the glove box. Since the bearings are Teflon, contamination of the liquid by lubricant is avoided. (D.L.C.)

27732 IMPROVEMENTS IN OR RELATING TO GAS BEARING SYSTEMS. Allan Barker and John Ashton (to United Kingdom Atomic Energy Authority). British Patent 876,136. Aug. 30, 1961.

A hydrodynamic gas-bearing system is designed with reciprocating movement for a compressor. The system comprises two bearing members, one of which is a sleeve enclosed in a sleeve and the other is a double-ended piston reciprocated in the sleeve by pressurized gas at one end while the other end pumps a contaminated gas. The piston is also rotated by a rotating magnetic field, thereby superimposing a sustained movement on a reciprocating movement. (D.L.C.)

27733 IMPROVEMENTS RELATING TO MASS SPECTROMETERS. Robert Derek Craig (to Associated Electrical Industries, Ltd.). British Patent 876,247. Aug. 30, 1961.

An ion source for mass spectrometers is designed with means for opening it to replace the sample without destroying the vacuum in the main body of the mass spectrometer. The means comprises a valve which has a plunger-seating seal for isolating the ion source from the mass spectrometer. (D.L.C.)

27734 IMPROVEMENTS IN OR RELATING TO BUTTERFLY VALVES. Norman Harold Mclaren and William Thomson Mitchell (to United Kingdom Atomic Energy Authority). British Patent 876,330. Aug. 30, 1961.

A butterfly valve is designed with relatively tight sealing. Sealing contact between rings and diaphragms is effected by pressurizing the spaces around the diaphragms. (D.L.C.)

27735 IMPROVEMENTS IN OR RELATING TO ELECTRIC HEATING MEANS. John Edward Hallett (to General Electric Co., Ltd.). British Patent 876,362. Aug. 30, 1961.

An electric heating means is designed for experiments on reactor fuel element cans. The means comprises a heat-resistant metal tube consituting an electric heating element and carrying on its outer surface a ceramic coating and a second heat resistant metal tube shrunk on to the first tube. The second tube may be divided into axially spaced sections upon which fuel element cans may be pushed. The tubes may be of stainless steel and the ceramic coating may be an alumina ceramic coating. (D.L.C.)

27736 IMPROVEMENTS IN OR RELATING TO TELEVISION VIEWING EQUIPMENT FOR NUCLEAR REACTORS. Robert Hugh Hall, Geoffrey Howard, and Cyril Charles Ovens (to United Kingdom Atomic Energy Authority). British Patent 875,376. Aug. 16, 1961.

A television viewing facility is designed for remote examination of the internal structure of a reactor for servicing operations. The facility comprises a support member with a movable arm and a television camera mounted on the arm. (D.L.C.)

Heat Transfer and Fluid Flow

27737 (AFOSR-872) HIGH TEMPERATURE HEAT TRANSFER TO CYLINDERS. Technical Note [Covering] March 1, 1959 to May 29, 1961. J. F. Cassidy, M. L. Ghai, and J. W. Reid (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Contract AF49(638)-243. 76p.

An analytical-experimental program was performed to provide basic knowledge of heat transfer from gases at high

temperatures. The objective was to obtain information regarding the forced convective heat transfer process associated with the transition flow region in a tubular test section. The experiments were conducted in a test stand utilizing high-temperature nitrogen-gas-flow discharge from an electrothermal generator developed to provide steady and reproducible flows for studies of this nature. Probe traverses made in the plenum chamber and test section inlet demonstrated that the temperature and pressure profiles were uniform. The experiments using this generator provided the heat transfer information required. The results, describing the forced convection heat transfer phenomenon in a transition flow, are presented, which quantitatively describe the Nusselt number variation with the Reynold's number and the pipe L/D ratio. The typical transition relation, $(Nu/Pr^{1/3}\ R.N.)(\mu s/\mu b)^{0.14}$ was plotted versus Reynold's number for various L/D ratios. A theoretical investigation of the laminar boundary layer in an electrical conducting fluid, for an arbitrarily applied magnetic field was performed. New advances in high temperature thermometry were made, which resulted from the development and use of a tungsten–tungsten–rhenium thermocouple system. Improved probe calibration methods demonstrated the probe's temperature and pressure measurement capabilities in gas temperatures as high as 5600°F. (auth)

27738 (KAPL-M-D1G-TD-11) FLOPSY I. M. Phillips (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 20, 1960. Contract W-31-109-Eng-52. 72p.

FLOPSY is an IBM-704 code written in FORTRAN which deals with fluid-flow distribution and pressure drop in any given network. It can handle both open and closed loop systems, and deals with resistances in series and in parallel. (B.O.G.)

27739 (MND-E-2417) ANPP NUCLEATE BOILING PROGRAM. Quarterly Progress Report No. 4. (Martin Co. Nuclear Div., Baltimore). June 1961. Contract DA-44-192-ENG-6. 89p.

A digital data reduction code, DARK, was prepared, used to work a test problem, and is presently being used to process preliminary data. The design of a detailed experimental program was completed; a total of 62 test runs, including steady-state reference tests, is planned. Tests were performed to determine the transient response of bulk coolant and surface thermocouples. A complete test section was installed in the loop and instrumented. All instrument and control installations were completed. Loop modifications and shakedown tests were completed. Operational checks of the voltage regulator for the motor-generator set indicated some circuit design problems. (auth)

27740 (NAA-SR-Memo-6576) ANALYSIS OF TURBULENCE INDUCED VIBRATIONS OF TUBULAR IMMERSION HEATERS. J. S. McDonald (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 30, 1961. 13p.

An analysis was made of motion of heater tubular elements due to self-excited oscillations and hydrodynamic forces applied at frequencies at which von Karman vortices are generated. Several different conditions of end fixity and structural behavior of the heater elements were considered. As a check on the calculations, comparison was made for one case with: (1) an experimental relation for pure parallel flow (the flow pattern for the immersion heater considered is much more complex), and (2) for a simple case of static loading. Agreement of the three results was within 28%. This comparison also indicated D'Alembert forces to be relatively insignificant, and that close estimates may be made considering static loading under velocity pressure. The heater elements should be safe from fatigue failure when stayed in the shown manner. (auth)

27741 (NASA-TN-D-765) EXPERIMENTAL HEAT TRANSFER AND PRESSURE DROP OF LIQUID HYDROGEN FLOWING THROUGH A HEATED TUBE. R. C. Hendricks, R. W. Graham, Y. Y. Hsu, and R. Friedman (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). May 1961. 62p.

Heat-transfer and pressure-drop characteristics of liquid parahydrogen flowing through a vertical tube are correlated on film conditions using the Martinelli parameter and a modified Dittus-Boelter experimental Nusselt number relation. Conditions investigated were: inlet pressure, 30 to 70 lb/sq in. abs; heat flux to 1 Btu/(sq in.)(sec); temperature differential, 50° to 750°R between wall and bulk. The friction losses are negligible relative to the momentum losses, and pressure drop may be predicted by the one-dimensional momentum equation. Paraortho conversion is discussed, and property data and a design procedure are presented. (auth)

27742 (NASA-TN-D-875) HEAT TRANSFER TO AN ELECTRICALLY CONDUCTING FLUID FLOWING IN A CHANNEL WITH A TRANSVERSE MAGNETIC FIELD. Morris Perlmutter and Robert Siegel (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1961. 41p.

An analysis is made of forced-convection heat transfer to laminar flow of an incompressible electrically conducting fluid between parallel plates. The plates are heated (or cooled) with a uniform wall heat flux, and heating within the fluid is present from viscous and electrical dissipations. The fluid enters the heated section of the channel with a uniform temperature, and the velocity distribution within the heated section is assumed to be fully developed. A magnetic field is imposed perpendicular to the channel walls, and there can be a net electric current flow parallel to the walls and perpendicular to the flow direction. The results give the wall temperature for various magnetic fields and electric current flows and the duct length required to obtain a fully developed temperature distribution in the fluid. (auth)

27743 (NASA-TN-D-1088) RADIANT HEAT TRANSFER BETWEEN NONGRAY PARALLEL PLATES OF TUNGSTEN. J. Robert Branstetter (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1961. 22p.

Net radiant heat flow between two infinite, parallel, tungsten plates was computed by summing the monochromatic energy exchange; the results are graphically presented as a function of the temperatures of the two surfaces. In general, these fluxes range from approximately 8 to 25% greater than the results of gray-body computations based on the same emissivity data. The selection of spectral emissivity data and the computational procedure are discussed. Nongray-body computational techniques for determining radiant heat flux appear practical provided the combination of select spectral emissivity data and the proper mechanized data-reduction equipment are brought to bear on the problem. (auth)

27744 (NASA-TR-R-116) NUMERICAL PREDICTIONS OF RADIATIVE INTERCHANGE BETWEEN CONDUCTING FINS WITH MUTUAL IRRADIATIONS. Max. A. Heaslet and Harvard Lomax (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.). 1961. 56p.

Analytical and numerical methods are developed that predict the flux of radiant energy from a family of thin, planar, conducting fins. For a symmetrical array of fins, extending out from a common edge, conducting heat internally, and radiating diffusely, a nonlinear integrodifferential equation is derived and solved. Specific results are given for parametric variations of conduction, emissivity, fin geometry, and base temperature. The techniques of calculation are studied for possible extensions. (auth)

27745 (TID-13425) A THEORETICAL STUDY OF THE TRANSIENT OPERATION AND STABILITY OF TWO PHASE NATURAL CIRCULATION LOOPS (thesis). Kermit Garlid, N. R. Amundson, and H. S. Isbin (Minnesota. Univ., Minneapolis). May 20, 1961. Contract AT(11-1)-926. 127p.

Lumped mathematical models of the time-dependent behavior of two-phase natural circulation loops were used to predict their operation and to explain the unusual instabilities sometimes observed. The resulting transient behavior for the more complex models solved with the Univac computer were in close agreement with the experimental data from the University of Minnesota low-pressure loop. Closed unstable regions rather than limits were predicted, and the specification of stability in terms of one parameter was found to be impossible. The slip ratio and the nature of its variation was found to be critical in determining the predicted loop behavior. Comparison of oscillations at low and high pressure indicated that the frequency difference is due largely to system geometry. The criterion for the absence of oscillations was found to be similar to one of the criteria for stability of chemical reactors. (D.L.C.)

27746 (TID-13440) THE COEFFICIENT OF VOLUME EXPANSION FOR WATER AND WATER VAPOR IN THE CRITICAL REGION. Technical Report No. 6. E. S. Nowak and R. J. Grosh (Purdue Univ., Lafayette, Ind. School of Mechanical Engineering). July 1961. Contract AT(11-1)-1026. 60p.

A tabulation is given for the coefficient of volume expansion for water and water vapor along eleven isobars in the critical region encompassed by pressures from 3000 to 4000 psia and temperatures from 690 to 750°F. Graphical techniques were employed to derive these values from precise P-V-T data. The over-all error in the derived values of the volume expansion coefficient was estimated to be within 5%. However, in the region of maximum values for the coefficient of volume expansion along the various isobars, the uncertainty in the derived values is estimated to be between 5 to 30%. (auth)

27747 SOLUTION OF SEVERAL PROBLEMS OF AIR MOTION IN THE PRESENCE OF DISSOCIATION AND IONIZATION. S. S. Kvashina and V. P. Korobeninikov. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekh. i Mashinostr., No. 2, 34-41(1960). ARS (Am. Rocket Soc.) J., 31: 997-1002(July 1961).

Methods are presented for calculating the thermodynamic properties of air, at 1000 to 20,000°K and 0.001 to 1000 atm. Effects of dissociation and ionization are considered, and are assumed to have equal influences on the properties of the air. Riemann waves and shock waves in the air are studied. Shock waves associated with air flow around pistons and cones are examined. (T.F.H.)

27748 HEAT TRANSFER IN A TURBULENT FLOW OF LIQUID METAL. V. I. Subbotin, M. Kh. Ibragimov, M. N. Ivanovskii, M. N. Arnol'dov, and E. V. Nomofilov. Atomnaya Energ., 10: 384-6(Apr. 1961). (In Russian)

The turbulent heat transfer coefficient, the ratio of E for liquid metals, and the effects of heat conductivity are determined. The turbulent heat transition distribution coefficient along the cross section of a tube is plotted for various Re numbers, and correlation curves of analytical and experimental data on the temperature field in heavy liquid metal are given. (R.V.J.)

27749 AN ANALYTICAL SOLUTION FOR A DOUBLE PIPE HEAT EXCHANGER. S. L. Sullivan, Jr. and C. D. Holland (A. and M. College of Texas, College Station). Ind. Eng. Chem., 53: 699-701(Sept. 1961).

The coefficient for the transfer of heat to gases in turbulent flow, which varies linearly with the bulk temperature of the gas over wide ranges of temperature, led to the development of a highly accurate formula for the calculation of the surface area required to effect a given heat-transfer specification. The formula takes into account the variation of the physical properties of the system with temperature. An example with carbon dioxide is given. (P.C.H.)

27750 MASS TRANSFER THROUGH LAMINAR BOUNDARY LAYERS—3a. SIMILAR SOLUTIONS OF THE b-EQUATION WHEN B = 0 AND $\sigma \geq 0.5$. H. L. Evans (Commonwealth Scientific and Industrial Research Organization, Homebush, New South Wales, Australia). Intern. J. Heat and Mass Transfer, 3: 26-41(Aug. 1961). (In English)

Using a form of expansion first suggested by Merk, series are given for evaluating accurately the "wall gradient" (b_0/B) for the case when no mass flows through the phase boundary. These cover wide ranges of main-stream pressure gradient and give good accuracy for any value greater than 0.5 of the Prandtl/Schmidt number σ. Values obtained compare well both with the few exact solutions given in the literature and with exact numerical integration. Curves are drawn of a number of other functions obtained from this "wall gradient." (auth)

27751 RADIATIVE HEAT EXCHANGE BETWEEN SURFACES WITH SPECULAR REFLECTION. E. R. G. Eckert and E. M. Sparrow (Univ. of Minnesota, Minneapolis). Intern. J. Heat and Mass Transfer, 3: 42-54(Aug. 1961). (In English)

A method was developed for calculating the radiant interchange in an enclosure containing specularly reflecting surfaces. Consideration was given to systems composed of two specular surfaces and an unrestricted number of black surfaces. The method was illustrated by numerical examples and comparisons were made with the heat transfer results for diffusely reflecting surfaces. (auth)

27752 THEORY OF THE STEADY LAMINAR BUOYANT FLOW ABOVE A LINE HEAT SOURCE IN A FLUID OF LARGE PRANDTL NUMBER AND TEMPERATURE-DEPENDENT VISCOSITY. D. B. Spalding and R. G. Cruddace (Imperial Coll. of Science and Tech., London). Intern. J. Heat and Mass Transfer, 3: 55-9(Aug. 1961). (In English)

Schuh's theory of steady laminar flow above a line heat source in a fluid with Pr = 0.7 is extended to fluids such as heavy oils. The solution is valid for all fluids of high Prandtl number, regardless of whether the viscosity is temperature-dependent or not. (auth)

27753 TURBULENT HEAT TRANSFER IN LIQUID METALS. FULLY DEVELOPED PIPE FLOW WITH CONSTANT WALL TEMPERATURE. N. Z. Azer (Univ. of Alexandria, Egypt) and B. T. Chao. Intern. J. Heat and Mass Transfer, 3: 77-83(Sept. 1961). (In English)

Nusselt number and temperature profile for low Prandtl number fluids of constant properties flowing in a smooth pipe with constant wall temperature are evaluated. Use is

made of the theoretical expression for the ratio of eddy diffusivities for heat and momentum. For practical calculation of film coefficient of heat transfer, an interpolation formula is proposed: $N_{Nu} = 5 + 0.05\ N_{Pr}^{0.25}\ N_{Pe}^{0.77}$, which fits the calculated data with a maximum deviation of less than 11% for $N_{Pr} < 0.1$ and $N_{Pe} < 15{,}000$. Temperature profiles for several Prandtl and Reynolds numbers are compared with the case of constant wall flux. (auth)

27754 TWO-DIMENSIONAL UNSTEADY INCOMPRESSIBLE LAMINAR DUCT FLOW WITH A STEP CHANGE IN WALL TEMPERATURE. M. Perlmutter and R. Siegel (Lewis Research Center, Cleveland). Intern. J. Heat and Mass Transfer, 3: 94-107(Sept. 1961). (In English)

Analytical solutions are obtained of transient heat transfer for unsteady incompressible laminar flow between parallel plates. The transient is caused by simultaneously changing with time the driving pressure of the fluid and the wall temperature. The solution is first obtained for the case where the inside surfaces of the channel walls undergo a specified step in temperature, that is, the heat-transfer resistance of the wall is neglected. Then some results are given where the temperature is specified at the outside surfaces of the walls and the transient heat conduction through the walls is taken into account. A few numerical examples are carried out to illustrate the method. (auth)

27755 HEAT TRANSFER IN MAGNETOHYDRODYNAMIC FLOW BETWEEN PARALLEL PLATES. R. A. Alpher (General Electric Research Lab., Schenectady, N. Y.). Intern. J. Heat and Mass Transfer, 3: 108-12(Sept. 1961). (In English)

An analysis is presented of convective heat transfer in the fully developed laminar flow of an incompressible conducting fluid between parallel plates through a transverse magnetic field. In particular the earlier analysis of Siegel involving non-conducting plates is corrected and extended to plates of finite conductivity. (auth)

27756 STEADY STATE TEMPERATURE DISTRIBUTION AND HEAT FLOW IN PRISMATIC BARS WITH ISOTHERMAL BOUNDARY CONDITIONS. M. J. Balcerzak and S. Raynor (Northwestern Univ., Evanston, Ill.). Intern. J. Heat and Mass Transfer, 3: 113-25(Sept. 1961). (In English)

Steady state two-dimensional temperature distribution and heat flow in prismatic bars with isothermal boundary conditions and various external geometry were computed and tabulated. The method of conformal mapping was used. (auth)

27757 APPROXIMATE CALCULATION METHOD FOR HEAT TRANSFER IN LAMINAR BOUNDARY LAYERS WITH CONSTANT SURFACE TEMPERATURE. A. G. Smith and V. L. Shah (Coll. of Aeronautics, Cranfield, [Eng.]). Intern. J. Heat and Mass Transfer, 3: 126-32(Sept. 1961). (In English)

A simple method for calculating heat transfer in a laminar, constant property, constant surface temperature flow was described by Smith and Spalding. The method is extended to the range of Prandtl numbers 0.7 to 10. Examples are given of heat transfer calculations for ellipses of 2 : 1 and 4 : 1 fineness ratio. (auth)

27758 INFLUENCE OF TURBULENCE ON THE TRANSFER OF HEAT FROM PLATES WITH AND WITHOUT A PRESSURE GRADIENT. J. Kestin, P. F. Maeder, and H. E. Wang (Brown Univ., Providence). Intern. J. Heat and Mass Transfer, 3: 133-54(Sept. 1961). (In English)

Kestin and Maeder have demonstrated the existence of two effects produced by an increase in the turbulence intensity of the free-stream in the case of cross-flow past a circular cylinder. An increase in turbulence intensity causes earlier transition and affects the flow pattern about the body. An increase in turbulence intensity causes local changes in the coefficients of heat transfer and, presumably, in the flow pattern in the boundary layer. The present investigation shows that the local effect is completely absent in the case of a flat plate at zero incidence. This is a remarkable difference between the present case and that of a cylinder. A qualitative explanation of this difference was that large effects from changes in the free-stream turbulence can be produced only in the presence of pressure gradients. This conclusion was tested by imposing a favorable pressure gradient on the plate. It was found that small changes in the turbulence intensity of the free stream cause large changes in the coefficient of heat transfer in the laminar range. Experiments with a pressure gradient were carried out in a preliminary way, and no exhaustive measurements were undertaken at this stage. The effect on turbulent boundary layers as well as the effect of adverse pressure gradients were not investigated. The experimental arrangement and the techniques used in measurement are described in detail; the accuracy is carefully examined and detailed check-measurements of velocity profiles were undertaken in order carefully to correlate the heat transfer measurements with the different flow regimes which are possible in the boundary layer. (auth)

27759 APPLICATION OF THE DEFECT LAW TO THE DETERMINATION OF THE AVERAGE VELOCITY AND TEMPERATURE IN TURBULENT PIPE FLOW. William Squire (Southwest Research Inst., San Antonio). Intern. J. Heat and Mass Transfer, 3: 155-8(Sept. 1961). (In English)

The defect law is applied to the axial and ordinate methods used for determining the average velocity and temperature in turbulent pipe flow. The axial method uses the velocity or temperature on the axis and a correction factor which is a function of Reynolds number for the velocity and of Reynolds and Prandtl number for temperature. The ordinate method is based on measuring the velocity or temperature at a point where its value is equal to the average value. These methods are limited to the restriction of essentially isothermal flow so that there is no marked variation of fluid properties across the profile. The axial method used here is applicable only to smooth round pipes, however the ordinate method is applicable to both smooth and rough round pipes. The defect laws result in an appreciable simplification of the analysis, but gives results somewhat different from those obtained using the universal laws. The small difference may be explained by the difference of the constant between smooth and rough pipe and the Reynolds number dependence. (N.W.R.)

27760 NON-STATIONARY HEAT CONDUCTION IN HEAT-PRODUCING ELEMENTS OF A NUCLEAR REACTOR. V. S. Ermakov, I. P. Zhuk, and O. I. Yaroshevich (Inst. of Power Engineering, Academy of Sciences, Minsk). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 5, 96-9(May 1961). (In Russian)

The transient heat conduction in a water cooled, water moderator reactor is solved by a Laplace transform method. The results are correlated with data obtained on a hydraulic analog computer. (tr-auth)

27761 AN APPROXIMATE SOLUTION OF FICK'S DIFFUSION EQUATION. T. Tsang (Argonne National Lab., Ill.). J. Appl. Phys., 32: 1518-20(Aug. 1961).

An approximate method of solving Fick's diffusion equa-

tion (or the heat conduction equation) with variable diffusion coefficients is discussed. Simple solutions may be obtained. In one example, the result appears to be in good agreement with the more elaborate numerical calculations by Crank. (auth)

27762 TRANSIENT TEMPERATURE DISTRIBUTION OF THE CYLINDRICAL FUEL ELEMENT IN THE CASE OF BOUNDARY CONDITIONS BEING TIME DEPENDENT. Wiesław Ciechanowicz (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 317-24 (1961). (In English)

The solution of the partial differential equations describing thermal processes in the fuel-channel of the reactor core is studied. These equations are solved with respect to the fuel element temperature, by means of the Hankel and Laplace transforms. The solution of the equations is the transient temperature distribution of the cylindrical fuel element, when the coolant temperature is a function of position and time. (auth)

27763 DYNAMIC BEHAVIOUR OF FORCED-FLOW EVAPORATOR SYSTEMS. P. Profos. Sulzer Tech. Rev., 42: No. 4, 5-12(1960).

The dynamic control behavior of forced-flow evaporator systems is of considerable importance in the control of once-through forced-circulation boilers and drum-type boilers with steaming economizers. It plays a large part in deciding the character of the feed control system, and to some extent it also affects the properties of the boiler as a whole. A combined graphical and mathematical method is developed by which the transfer characteristics can be determined from the design data of the steam generator. This incidentally permits a clear picture to be gained of the complicated processes taking place in a heating system of this kind under transient conditions. (auth)

27764 CALCULATION OF THE DYNAMIC BEHAVIOUR OF HEAT EXCHANGERS WITH THE AID OF ANALOGUE COMPUTERS. L. Acklin and F. Läubli. Sulzer Tech. Rev., 42: No. 4, 13-22(1960).

It is often required to heat or cool a flow of liquid to a constant temperature. The deviation of the outlet temperature of the flowing medium from the desired value is detected by a controller and signalled to a correcting unit. The transfer behavior of all parts of the control loop must be known if the variation of the outlet temperature with time and thus the optimum setting of the correcting unit are to be calculated in advance. The dynamic behavior of controllers, measuring units, and positioning elements can usually be allowed for in these cases by simple time delays. It therefore remains only to calculate the dynamic behavior of the heat exchanger and to present it in a form suitable for an analog computer. A method for this purpose is described. (auth)

27765 EFFECT OF TUBE SPACING AND ARRANGEMENT UPON THE FOULING CHARACTERISTICS OF BANKS OF TUBES. P. Profos and H. N. Sharan. Sulzer Tech. Rev., 42: No. 4, 31-43(1960).

The utilization factor of a steam plant depends to a large extent on the length of time for which the boiler can be kept in operation without overhauling. This time is affected not only by the properties of the fuel but also by the susceptibility of the boiler heating surfaces to fouling. The geometrical arrangement of the tubes in the banks here plays an important part, and a knowledge of the influence exercised by tube arrangement is therefore essential if optimum design of heating surfaces is to be achieved. The results of model tests on this problem are described. The tests are conducted for obtaining mathematical data relating to the effect of pipe geometry on the fouling of tube banks. (auth)

27766 OPTIMUM TEMPERATURE OF REGENERATIVE WATER HEATING IN NUCLEAR POWER PLANTS. D. D. Kalafati (Inst. of Power Engineering, Moscow). Teploenergetika, No. 4, 74-81(Apr. 1960). (In Russian)

The optimum temperature for regenerative heating in heterogeneous nuclear power plants is analyzed. Formulas are developed for optimum regenerative heating for given coolant and reactor conditions. (tr-auth)

27767 PROCEEDINGS OF THE 1961 HEAT TRANSFER AND FLUID MECHANICS INSTITUTE, HELD AT UNIVERSITY OF SOUTHERN CALIFORNIA, JUNE 19, 20, 21, 1961. R. C. Binder, M. Epstein, R. L. Mannes, and H. T. Yang, eds. Stanford, California, Stanford University Press, 1961. 243p.

Seventeen papers are presented on fundamental research results of current interest in heat transfer, fluid mechanics, and related fields. Only complete investigations are reported. Information is presented on such topics as hot-wire anemometer measurements, turbulence, free mixing, shock wave interaction, laminar boundary layer problems, steam-water flows, acoustic vibrations, liquid disintegration, spray condensers, nucleate boiling, hypersonic interaction, ionization trails, electric arc, re-entry shields and other related topics. (N.W.R.)

27768 IMPROVEMENTS IN AND RELATING TO HEAT EXCHANGERS. Heinrich Hugo Ludolf Ritz (to C. A. Parsons & Co. Ltd.). British Patent 874,121. Aug. 2, 1961.

A tubular heat exchanger is described in which the tubes are arranged on an annulus within a casing. If the heat exchanger is used in a nuclear power plant, the cooling gas from the reactor is circulated through the casing and the water is circulated through the tubes. The tubes are supported in places by radially extending walls of the support member which extends through the annulus in an axial direction with respect to the casing. The radially extending walls divide the space between the tubes and the support member into a number of separate flow channels extending in the general direction of the axis of the casing. The walls and the tubes are disposed at an angle to one another. The tubes may be helically disposed with respect to the axis of the casing and the radially extending walls may be straight or the tubes may be straight and the walls may be helical. For the former tube arrangement the fluid is admitted to the tubes from an annular chamber at one end of the casing and leaves the tubes by an annular chamber at the other end of the casing; the other fluid flows over the tubes in the opposite direction. For the latter tube arrangement the fluid flows through the support member and into the inlet header from which it enters the tubes and flows in the reverse direction through the tubes to an outlet header; the other fluid flows through the casing and over the tubes. (N.W.R.)

27769 IMPROVEMENTS IN HEAT EXCHANGERS FOR INDIRECTLY HEATING A FLUID BY MEANS OF A VAPOUR AND LIQUID MIXTURE AND TO METHODS OF INDIRECTLY HEATING A FLUID BY A VAPOUR AND LIQUID MIXTURE. (to Babcock & Wilcox Co.). British Patent 876,308. Aug. 30, 1961.

A heat exchanger is designed for use with a vapor—liquid mixture led from a boiling water reactor by natural circulation. The heat exchanger has means for separating the vapor and liquid and passing the separated vapor and liquid into vapor and liquid heat exchanger elements. (D.L.C.)

Instrumentation

27770 (AERE-M-827) SOME TESTS ON LITHIUM GLASS SCINTILLATORS FOR DETECTING NEUTRONS. D. H. C. Harris (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1961. 15p.

Two samples of scintillator glass containing Li^6 were studied (on a neutron crystal spectrometer) to determine their usefulness as detectors in thermal neutron experiments with reactor neutron beams. It is concluded that for most applications the Li^6 glass detector is superior to both the BF_3 counter, and scintillators using ZnS. (auth)

27771 (APEX-748) D140E1 HEATING RATE SENSOR PROGRAM CLOSING REPORT. R. R. Swope (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). July 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 41p.

The D140E1 heating rate sensor program is described. The design, fabrication, evaluation, and problems associated with the task are discussed. Conclusions and recommendations are also included. (auth)

27772 (AWRE-O-61-60) T4813 Q BAND DETECTOR AND TRANSISTOR AMPLIFIER, AND THE T4814 TRANSISTOR PRE-AMPLIFIER. K. G. Beauchamp and B. L. Elphick (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). July 1961. 17p.

A heavily shielded transistor amplifier with self-contained batteries is described. The bandwidth is 10 Mc/s and the gain × 50. An output of = 0.5 V into 75 Ω load is available. The first version was an integral Q band crystal detector connected to the input, while the second is fed from a 75 Ω source. (auth)

27773 (DOFL-TR-919) AIRBORNE TAPE RECORDER FOR USE IN NUCLEAR ENVIRONMENTS. Joseph M. Vallin (Diamond Ordnance Fuze Labs., Washington, D. C.). June 20, 1961. 66p.

An airborne multitrack magnetic tape record and playback system was designed, constructed, and subjected to nuclear environmental tests that indicate a correct design approach. This system, designed specifically to record and playback, while airborne, the data from high-altitude nuclear weapon effects tests, required structural strength to withstand missile-launch environments and electronic circuitry capable of unaffected operation in nuclear environment. Extreme reliability of tape transport, electronics, programming techniques, and timing and telemetry devices was required. In the operational sequence, (1) an internal timer actuates the recording process shortly before the detonation; (2) voltages from various transducers are recorded; and (3) the system plays back the recorded information several times through radiotelemetry links to the ground. (auth)

27774 (DP-584) ELECTRON MULTIPLIER AS A DETECTOR FOR A SURFACE IONIZATION MASS SPECTROMETER—PERFORMANCE. Philippe J. P. Chastagner (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). July 1961. Contract AT(07-2)-1. 11p.

Installation of an electron multiplier in a surface ionization mass spectrometer reduced from 10 to 0.01 microgram the amount of actinide sample required for isotopic analysis. (auth)

27775 (GA-2060) APPARATUS AND PROCEDURE FOR MEASURING REACTION OF THORIUM—URANIUM CARBIDES IN MOIST AIR. C. S. Luby (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Mar. 20, 1961. Contract AT(04-3)-314. 10p.

A recording differential balance and associated equipment for measuring the hydrolysis rate of $(Th,U)C_2$ in moist air are described. Procedures for loading and operating the balance are outlined. Experimental results are presented in GA-2068. (D.L.C.)

27776 (NAA-SR-6034) THE SPECIFIC HEATS AND RESISTIVITIES OF MOLYBDENUM, TANTALUM, AND RHENIUM FROM LOW TO VERY HIGH TEMPERATURES. R. E. Taylor and R. A. Finch (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 15, 1961. Contract AT(11-1)-GEN-8. 37p.

An a-c bridge method for measuring the electrical resistivities of conductors from ambient to 2000°K and a pulse heating method for measuring the specific heat of conductors from 10°K through the melting temperature are described. Results are accurate within 4% for molybdenum, tantalum, and rhenium. The specific heats of all three metals increase rapidly near their melting temperatures. Apparently, vacancy formation does not account for all of this increase, suggesting that additional mechanisms are also involved. (auth)

27777 (NASA-TN-D-1054) A TECHNIQUE FOR INCREASING THE SENSITIVITY OF A SOLID-STATE FISSION PROBE. Robert Steinberg (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1961. 11p.

It was observed that the sensitive area of a semiconductor fission probe can be increased many times by utilizing a series technique in the fabrication of the detecting element. Large area detectors (~1 cm^2) were constructed with a corresponding thermal neutron sensitivity of 0.90×10^{-3} counts/neutron/cm^2. (auth)

27778 (NASA-TN-D-1080) SIGNAL CONDITIONING FOR SATELLITE BORNE ENERGETIC-CHARGED-PARTICLE EXPERIMENTS. George H. Ludwig (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Aug. 1961. 19p.

Some of the instrumentation elements developed for conditioning signals from spacecraft-borne detectors prior to telemetering are described. A present-generation three-detector system is given which illustrates the integration of such basic elements into a complex system. (D.L.C.)

27779 (NRL-5604) PORTABLE PRECISION FREQUENCY METER AND PRECISE SIGNAL GENERATOR. J. E. McGeogh and G. K. Jensen (Naval Research Lab., Washington, D. C.). Feb. 7, 1961. 39p.

A laboratory model of a precise frequency meter and signal generator intended primarily for portable operation has been developed, constructed, and measured. The model is 1.5 cu ft, weighs 43 lb, and uses a separate power supply. It provides frequency measurement in the 0 to 1 Mc range on band 1 to an accuracy within 1 ppm when using the internal reference or to an accuracy equal to that of an external 100-kc reference. A method for extending operation to the next three higher decade ranges was provided for, although it is not constructed in the laboratory model. Although the model was originally intended for use only as a frequency meter, the chosen method of measurement incorporates a precise, direct-reading, six-decade frequency generator which may be used as a signal generator. Care was exercised to provide an output signal with all extraneous frequencies attenuated to a level much lower than required in the frequency meter, in order that the unit may also be used

as a highly accurate, direct-reading decade signal source. The instrument may then be used as a driver for other equipment or as a laboratory instrument. (auth)

27780 (RISÖ-22) LABORATORY MANUAL FOR SOME HIGH-LEVEL CHEMICAL DOSIMETERS: FERROUS SULPHATE, OXALIC ACID, CERIC SULPHATE, POLYVINYL-CHLORIDE FOILS. I. G. Draganic, N. W. Holm, and J. E. Maul (Denmark. Atomenergikommissionen. Forsogsinstitut, Risö). July 1961. 31p.

A manual is presented for the use of the following chemical dosimeters: ferrous sulfate, oxalic acid, and ceric sulfate solutions and polyvinyl chloride foils. Their application is restricted to high-energy radiation, and the measurable range covers 2×10^3 to 1.6×10^8 rads. (D.L.C.)

27781 (SCTM-20-61(81)) A HIGH-G ACCELEROMETER CALIBRATOR. D. F. Lange (Sandia Corp., Albuquerque, N. Mex.). Aug. 1961. 13p. Contract AT(29-1)-789.

To calibrate accelerometers for subsequent use in water-entry shock tests, a technique using a shock-cord accelerator was devised to subject the accelerometers to a 10,000-g, 300-microsecond shock pulse in the laboratory. The new calibration technique overcomes several previous limitations of shock-cord machines. (auth)

27782 (SCTM-208-61(11)) DIELECTRIC BREAKDOWN OF PRINTED WIRING ASSEMBLIES IN ELECTRONIC PACKAGES. Robert P. Noble (Sandia Corp., Albuquerque, N. Mex.). Aug. 1961. 21p.

The nature of dielectric breakdown in electronic packages is discussed. Published works on electrical breakdown in gases and solids are also discussed, and various data useful for Sandia design information are reduced to convenient form. (auth)

27783 (TID-12844) RESEARCH AND INVESTIGATION LEADING TO METHODS OF GENERATING AND DETECTING RADIATION IN THE 100 TO 1000 MICRON WAVELENGTH RANGE OF THE SPECTRUM. Final Report. Basil Hakki (Illinois. Univ., Urbana. Electrical Engineering Research Lab.). Feb. 28, 1961. Contract AT(11-1)-392. 63p.

A high energy, tightly bunched, beam was used to generate coherent electromagnetic radiation in the low millimeter range. The devices used to couple power out of this beam were: a high order mode right circular cylindrical cavity, a dielectric tube resonator, a dielectric tube waveguide, a helix waveguide, and a slab of dielectric. Interaction of the beam with these devices was experimentally verified and agreement with theory is reasonable. Cherenkov radiation in the slab of dielectric was shown to yield less power than the rest of the coupling schemes; however it has no mode interference problems. The coupling schemes which were fully analyzed but not experimentally tested include: Cherenkov radiation in a gyrotropic plasma waveguide, Cherenkov radiation in a gyrotropic plasma medium, and Doppler frequency shift from high energy electron bunches. A gas discharge frequency multiplier was used to generate the 13th harmonic of the fundamental at microwave frequencies. Analysis of this device was completed and agreement between theory and experiment was excellent. The gas discharge was also used as a frequency mixer at high power levels. Frequency multiplication in ferroelectric materials was shown to be impractical, at the present, because of the lack of a material which is sufficiently lossless and nonlinear. A Doppler-Helitron microwave oscillator was proposed. The mode of operation was theoretically analyzed but no experimental verification was done. A complete line of microwave components was developed for the 140 to 220 kmc band. This included: crystal multipliers, waveguide flanges, crystal detectors, bolometers; tunable shorts, VSWR measuring devices, frequency meters, tapered transitions, horns, variable phase shifters, power dividers, bends and twists, terminations, attenuators and mode converters. (auth)

27784 (TID-13491) A STUDY OF THE MECHANISM OF THE POISONING OF PROPORTIONAL COUNTERS (thesis). Charles Francis Smith, Jr. (Purdue Univ., Lafayette, Ind.). Feb. 1961. Contract AT(11-1)-694. 90p.

An attempt was made to obtain information concerning the mechanism and kinetics of the poisoning reaction of oxygen in a carbon dioxide-filled proportional counter. The counter consisted of a brass cylinder, sealed at the ends with plastic disks, and having an axial tungsten center wire. The O_2–CO_2 mixture was first put in the evacuated counter at a known pressure. Enough CO_2 was then added to bring the total pressure in the counter to the desired amount. The spectrum obtained from the poisoned mixture consisted of 2 peaks. A peak at normal pulse height was observed to decrease in intensity with increasing amounts of poison. A lower level peak increased in intensity and decreased in pulse height as more oxygen was added to the counting mixture. The total count rate was observed to be independent of oxygen pressure unless the poison pressure was high enough to cause the lower peak to shift below the setting of the lower discriminator. The shapes of the poisoned spectra were explained by assuming the only effect of the poison is to capture electrons as they drift toward the anode. (auth)

27785 (TID-13585) OPTICAL AND MECHANICAL PROPERTIES OF ALKALI HALIDE CRYSTALS. Final Report, February 1, 1959 to February 28, 1961. George C. Kuczynski (University of Notre Dame, Notre Dame, Ind.). Sept. 1, 1961. Contract AT(11-1)-731. 150p.

Mechanical Properties of Alkali Halides. Tensile, compression, and hardness measurements were made on KCl and NaCl crystals which were either clear or stained on their surfaces. Some measurements were also made on KCl crystals exposed to x or u-v radiation. Dislocations in KCl Crystals. The arrangement of dislocations in KCl after various treatments was studied with the etch pit technique. The formation of cracks was studied, and the mechanism of crack closure by annealing was found to be evaporation-condensation. Color Centers in KCl Crystals. Color centers induced by soft x rays in KCl crystals were studied by measuring absorption spectra and expansion during the irradiation. The concentration of F centers was found to increase with the amount of crystal deformation. The number of vacancies produced by irradiation as measured by crystal expansion was ~10 times greater than those measured optically. (D.L.C.)

27786 (TID-13587) THE CHANNELED IMAGE INTENSIFIER. Twelfth Quarterly Report for the Period April through June 1961. (Chicago. Univ. Labs. for Applied Science). Contract AT(11-1)-647. 37p. (LAS-SR-P150-12)

Completion of two five-inch image tubes is reported. Field emission from leads in the base tube interfered with the test program to such an extent that gain measurements can be made on the first four dynodes only. These appeared to be operating satisfactorily. To avoid further problems with field emission, a second tube was built which is cesium-free in the multiplier section. No testing was done on this tube. (J.R.D.)

27787 (UCRL-6424) HIGH TEMPERATURE MEASUREMENT AND PRODUCTION—A BIBLIOGRAPHY. (James H. Kennedy, Carl J. Wensrich, Glenn R. Maynard,

Theodore N. Cranford, and Carl Schweickert (California. Univ., Livermore. Lawrence Radiation Lab.). July 1961. Contract W-7405-eng-48. 118p.

A bibliography on measurement and production of high temperatures (above 1800°F) is presented. Since indexes and abstracts do not indicate the temperature range in which a particular device operates, references may appear that are not pertinent to the bibliography. Sources consulted include AEC Research and Development Card catalog, ASTIA Bibliography Service, Nuclear Science Abstracts 1959-1960, Engineering Index 1958-1960, Applied Science and Technology Index 1950-1960, Ceramics Abstracts 1950-1960, Chemical Abstracts 1950-1960, and Physics Abstracts 1950-1959. About 675 references. (J.R.D.)

27788 (WAPD-T-1064) DOUBLE-UNIT AUTOMATIC FLUX WIRE SCANNER. K. B. Carver and K. W. Brown (Westinghouse Electric Corp. Naval Reactors Facility, Idaho Falls, Idaho). Sept. 1959. Contract AT(11-1)-GEN-14. 19p.

For ANS Meeting, November 1959, Washington, D. C.

A double-unit automatic flux wire scanner was designed and put into operation for use in obtaining neutron flux profiles by the activation technique. The instrument consists of two scanner assemblies with the necessary information and a central control unit. Each scanner assembly consists of a stationary shielded cylinder, wire carriage assembly detector unit, and drive system. The reliability and reproducibility of the unit was determined. (M.C.G.)

27789 (AEC-tr-4475(p.241-4)) NEW BOREHOLE RADIOMETRIC APPARATUS WITH NEUTRON PROPORTIONAL AND SCINTILLATION COUNTERS. D. F. Bespalov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 209-12(1958).

Brief descriptions are given of instruments for registration of thermal neutrons and of apparatus for recording and examining borehole gamma radiation spectra. (J.R.D.)

27790 (AEC-tr-4781) A MOLECULAR BEAM ION SOURCE FOR THE MASS SPECTROMETRIC DETERMINATION OF THE ABUNDANCE OF URANIUM ISOTOPES. W. Bulang and K. H. Welge. Translated for Oak Ridge Gaseous Diffusion Plant from Z. Instrumentenk., 69: No. 6, 176-80(1961). 9p.

A Nier type ion source with a molecular beam cast inlet system was developed making it possible to obtain a high precision in mass spectrometric determination of the abundance of uranium isotopes while possessing a long life with infrequent breakdown and presenting practically no memory effect. The arrangement of the ion source and molecular beam inlet system is described. In the abundance determination of the U^{235} and U^{238} isotopes the UF_5^+ streams are measured for masses 330 and 333. Methods of preventing a background and the memory effect are discussed. (M.C.G.)

27791 (CEA-tr-A-960) CONTRÔLE ET RÉGLAGE DES NIVEAUX DE REMPLISSAGE AU MOYEN DES ISOTOPES RADIOACTIFS. (Control and Regulation of Filling Levels by Means of Radioactive Isotopes). A. Trost. Translated into French from Atompraxis, 5: No. 2, 59-66(1959). 50p.

Devices designed for the control and regulation of filling levels are illustrated. Intermittent level determination, control of filling limits, and continuous filling determinations using γ radiation are described. The use of β radiation in level controls is also reviewed. Protection against radiation is considered. (J.S.R.)

27792 (CEA-tr-R-1267) SPECTROMETRE A SCINTILLATIONS POUR NEUTRONS RAPIDES. (Scintillation Spectrometer for Fast Neutrons). U. K. Khudenskii and U. A. Tzvilin. Translated by S. Tarassenko from Byulletin Izobretenii Patent No. 124555. 2p.

A scintillation spectrometer for the detection of fast neutrons by means of recoil protons is described. It contains a cylindrical scintillation detector constructed with the aid of scintillating plastics at the interior of which are placed, parallel to the cylinder generators, filaments of another plastic scintillating material with different emission spectra. Two photomultipliers in an anticoincident circuits are used. The spectrometer is distinguished by the fact that the plastic scintillators of the detector possess different emission spectra and that the photomultipliers have photocathodes in which the corresponding spectral characteristics are different. (J.S.R.)

27793 (CEA-tr-R-1342) FLUCTUATIONS DE LA COMPACITÉ DES TRACE PRODUITES PAR DES PARTICULES CHARGÉES DANS LES ÉMULSIONS NUCLÉAIRES. (Variations in the Compactness of Tracks Produced from Charged Particles in Nuclear Emulsions). K. S. Bogomolov. Translated into French from Zhur. Nauch. i Priklad. Fot. i Kinematografii 5: No. 3, 168-72(1960). 17p.

Fluctuations in the density of particle tracks were studied in Type II emulsions having different degrees of aging and a sensitivity between 15 and 55 grains/100 μ in the track of a relativistic particle. The distribution characteristics were determined within large limits around its absolute value. The magnitude of the track density was determined by taking into consideration the following factors: the number of microcrystals met along the particle track, the number of primary ionization acts, and the receptivity (sensitivity) to ionization of the crystals met. The experimental values of the fluctuations agree approximately with the binomial distribution curve calculated. (J.S.R.)

27794 (CEA-tr-X-389) CARACTÉRISTIQUES DES COMPTEURS À SCINTILLATION. (Characteristics of Scintillation Counters). T. Radoszewski. Translated into French from Nukleonika, 5: 361-8(1960). 22p.

A scintillation counter was studied with respect to the appearance of the plateau. The factors which affect the appearance and the value of the plateau were verified. The criteria for the selection of the operational parameters of the counter and means for determining them are given. (tr-auth)

27795 (SCL-T-378) METHODS OF MEASURING SPECIFIC HEAT AT HIGH TEMPERATURES. Seizo Nagasaki and Yutaka Takagi. Translated from Oyo Butsuri, 17: 104-9(1948). 11p.

A method for measuring specific heat at high temperatures is discussed. By supplying a certain appropriate amount of energy to the sample through its heating coil, and if the escape of this energy to the outside can be prevented completely, the specific heat can then be obtained immediately simply by measuring the temperature rise in the sample. The apparatus used for the measurements is described and the equations used for calculations are given. Results are given for Al, Mg_3Cd, and S. The method is compared with that of Sykes and Jones. (M.C.G.)

27796 A HIGH-FIELD EMISSION IONIZATION DETECTOR FOR GAS CHROMATOGRAPHY. Örn Wahlroos (Lab. of the Foundation for Chemical Research, Biochemical Inst., Helsinki). Acta Chem. Scand., 15: 708-9(1961). (In English)

A field-emission type ionization detector working at

normal pressure and temperature with argon as carrier gas is described. It is designed so that the ionization current is dependent on the concentration of vapor molecules in the electric field and that the too rapid current rise due to secondary processes at the cathode would be avoided. (L.N.N.)

27797 MONITORING WITH LOGARITHMIC IONIZATION CHAMBERS. Karl Heinz Sczepannek. A E G Mitt., 50: 301-4(Aug.-Sept. 1960). (In German)

Area monitoring installations serve to protect personnel from radioactive hazards. They consist of detector units and a central apparatus. Their arrangement and operation are described, and their uses outlined. (tr-auth)

27798 MEASUREMENT OF WEAK RADIOACTIVITIES IN LIQUIDS USING AN ANNULAR APPARATUS. Elmar Schrüfer. A E G Mitt., 50: 317-18(Aug.-Sept. 1960). (In German)

A measuring apparatus is described with which activities of solutions from 10^{-6} $\mu c/cm^3$ can be continuously measured. The measurements can be carried out in the presence of hard gamma radiation. (tr-auth)

27799 THE DEPENDENCE OF THE BUBBLE DENSITY FOR AN IONIZING PARTICLE ON THE TEMPERATURE AND PRESSURE IN A BUBBLE CHAMBER. PART I. EXPERIMENTAL PROCEDURE AND RESULTS. B. Alfredsson and T. Johansson (Univ. of Lund, Sweden). Arkiv Fysik, 19: 383-96(1961). (In English)

An account is given of measurements on the bubble density for 18 Mev electrons as a function of the pressure drop and temperature in a bubble chamber. The investigation was carried out with propane, Freon-12, and sulphurhexafluoride in the temperature regions (52–68)°C, (68–82)°C, and (10–20)°C respectively. The bubble densities investigated are in the interval (5–30) bubbles/cm. From the results obtained it can be concluded that the operating temperatures of the liquids used lie in the same region when expressed in reduced temperatures. It is also shown that the bubble density can approximately be represented by a simple formula containing the energy required to create a bubble in the chamber. (auth)

27800 THE DEPENDENCE OF THE BUBBLE DENSITY FOR AN IONIZING PARTICLE ON THE TEMPERATURE AND PRESSURE IN A BUBBLE CHAMBER. PART II. COMPARISON BETWEEN THEORIES AND EXPERIMENTAL RESULTS. T. Johansson (Univ. of Lund, Sweden). Arkiv Fysik, 19: 397-415(1961). (In English)

The bubble nucleating mechanism in the bubble chamber is discussed in view of some of the existing experimental evidence for a description of the process, either by the occurrence of free electrical charges on the bubbles as required by the electrostatic theory or a localized heating of small regions in the liquid as given by the thermal theory. Calculations of the temperature dependence of operating conditions to be expected when either theory is correct were made with the use of a somewhat simplified model. The calculated temperature dependences were also compared with those experimentally obtained by measurements of the bubble density as a function of pressure drop and temperature in the liquid for electrons of 18 Mev mean energy. The liquids used are propane, Freon-12, and sulphurhexafluoride. The experimental results for these liquids are in very good agreement with the behavior of the bubble chamber as estimated from the thermal theory. (auth)

27801 SCINTILLATING GLASSES OF HIGH LIGHT YIELD FOR DETECTING NEUTRONS. V. K. Voitovetskii and N. S. Tolmacheva. Atomnaya Energ., 10: 504(May 1961). (In Russian)

The scintillation efficiency of thin $Li_2O \cdot 3SiO_2 \cdot 0.08Al_2O_3$ layers remains practically constant with cerium concentration from 0.05 to 0.01, and with electron excitation the efficiency is 8 to 9% of that of the NaI(Tl) scintillator. The optimum for 1 cm thick scintillating glass is found at 0.05 to 0.06 cerium concentration. The light yield of such glass for electrons and products of neutron reactions with Li^6 is 3.4 to 3.7. The differential amplitude spectrum of pulse intensities at the inlet of the scintillation counter with $Li_2O \cdot 3SiO \cdot 0.08Al_2O_3 \cdot 0.1CeO_2$ glass was plotted for scintillation excitation by thermal neutron reactions with Li^6; the peak half-width is 22.5%. The scintillation efficiency of thin $Li_2O \cdot 0.5CaO \cdot 4SiO_2 \cdot 0.13Al_2O_3 \cdot 0.1CeO_2$ glass is 11% of that of the NaI(Tl) crystal, and to a certain degree depends on the content of Al_2O_3(0.08 to 0.20) and cerium (0.06 to 0.10). With increase in thickness the optimum of cerium concentration is 0.06. (R.V.J.)

27802 USE OF A SCINTILLATION COUNTER TO DETECT α PARTICLES AND FISSION FRAGMENTS IN THE PRESENCE OF A STRONG β-RAY OR γ-RAY BACKGROUND. V. K. Voitovetskii and I. L. Korsunskii. Atomnaya Energ., 10: 505-6(May 1961). (In Russian)

The permissible maxima of γ-ray and electron backgrounds are raised by replacing the constant resistance R at the photomultiplier output with a crystalline diode as nonlinear element. Diode operating characteristics are discussed. The common errors encountered in pulse overlap are eliminated in α particle recording. (R.V.J.)

27803 UNIVERSAL PRECISION β SPECTROMETER. V. M. Kel'man, B. P. Peregud, and V. I. Skopina. Atomnaya Energ., 10: 534-6(May 1961). (In Russian)

A precision magnetic β spectrometer with automatic control and recording is described. The highest resolving power of the apparatus is 0.014% at a solid angle of 0.006% of 4π and source dimensions 0.4×15 mm. The largest solid angle is 0.8% of 4π with resolving power of 0.11% and source dimension of 1.5×15 mm. At virtual angles of 0.2 and 0.05% of 4π the resolving power is 0.07 and 0.03%, respectively (the source dimensions 1.5×15 mm). (R.V.J.)

27804 USE OF A $CaSO_4$(Sm) PHOSPHOR IN DOSIMETRY. A. R. Krasnaya, B. M. Nosenko, L. S. Revzin, and V. Ya. Yaskolko. Atomnaya Energ., 10: 630-1(June 1961). (In Russian)

A previous investigation had shown that a $CaSO_4$(Mn) phosphor had a limited capacity to store light. In investigating the use of Pb, Zn, Bi, Ag, Tl, Co, Ba, Ni, Mg, Hg, Cd, Sr, and Sm as activators, it was found that only the $CaSO_4$(Sm–0.1 mol %) phosphor had an ample capacity for storing light with sufficient sensitivity. The thermoemission curve for the $CaSO_4$(Sm) phosphor has three peaks with maxima at 65, 120, and 200°C. The high-temperature (200°C) peak is the most intense with a light sum equal to 90% of the total light sum. The thermoluminescence spectra are the same for a wide range of beta and gamma energies. The stored light sum depends linearly on the dose from 0.1 to 25,000 r. At 40°C the phosphor loses 10% of its stored light sum in a week, exclusively at the expense of the first and second thermoemission peaks. The third peak retains its light sum for a month or longer. The third peak does not emit light at 70°C, but at 120°C it emits 60% of its stored light sum in 24 hours. On irradiating the phosphor at a dose strength of 0.005 r/hr for 42 days, it was found that the stored light sum was equal to the computed value corresponding to a total dose of 5 r. Visible light does not cause excitation of the $CaSO_4$(Sm) phosphor, but rather

causes it to lose some of its stored light energy (25% in 4 hours). This phosphor is suitable for use at elevated temperatures (up to 100°C) for prolonged measurements. (TTT)

27805 A TWO DIMENSIONAL, 1024-CHANNEL PULSE HEIGHT ANALYZER (DMA-1024). A. A. Rostovtsev, Yu. I. Il'in, A. S. Beregovskii, V. G. Tishin, V. E. Zezyulin, and B. A. Ermakov. Atomnaya Energ., 11: 58-9(July 1961). (In Russian)

Although the amplitude distribution of nuclear radiations can be determined by multichannel analyzers, quite often the available instruments do not suffice as 2 correlated nuclear events must be investigated. Such a problem requires an analyzer the channels of which are able to determine the distribution of coincidences of 2 electrical pulses from 2 correlated particles or quanta as a function of the energy or the time-of-flight of the particles. Such a spectrum is defined by a three dimensional surface. For 2 correlated events the spectrum may be defined by a two dimensional system using a two dimensional analyzer. Such an instrument, provided with 1024 channels was developed for pulse-height determinations. It contains a recording block and 2 identical sorting devices, recording only the coincidence pulses from the detectors. A ferrite core memory device is used. The channels are displayed in X–Y matrices ($32 \times 32 = 1024$). The dead-time of the instrument is about 150 microsec. A two dimensional spectrum of the γ radiation of Co^{60} is presented. (TTT)

27806 ELECTROACOUSTIC GAS THERMOMETER FOR MEASURING LOW TEMPERATURES. A. D. Brodskii. Izmeritel'naya Tekh., No. 6, 22-4(June 1961). (In Russian).

The velocity of sound in an ideal gas depends on the absolute temperature as follows: $C = \sqrt{\gamma RT/M}$, where $\gamma = c_p/c_v$ (the ratio of the heat capacities); R is the gas constant; M is the molecular weight of the gas, and T is the absolute temperature. The first resonant frequency f of a resonating tube having a length L is $f = C/2L$. By correcting for the linear thermal expansion of the resonator and by introducing the second viral coefficient for helium gas, it is possible to determine low temperatures with great accuracy by using this frequency method. The sensitivity of the method rises sharply with decreasing temperature (the sensitivity amounts to a change in frequency of 15 cycles per second per °C at 20°K). The boiling point of liquid hydrogen agreed within ± 0.03°C with the value found by the usual method of gas thermometry. The new electroacoustical gas thermometer can be used to determine absolute temperatures from 10 to 273.5°K. (TTT)

27807 CALCULATION OF THE GEOMETRY OF AN APPARATUS FOR SCATTERING STUDIES. F. R. Arutyunyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 12: No. 6, 109-20(1959). (In Russian)

In studying the corrections which must be applied in the investigation of cosmic ray scattering with a Wilson cloud chamber containing parallel lead plates, it was found that the presence of lead limits the effective volume of the chamber for observing scattering events at certain angles, causing a distortion of the true angular distribution of the events. Corrections factors taking into account the presence of lead in the plane of scattering and in a plane perpendicular to it which are dependent on the angular distribution of the events were derived. (TTT)

27808 PHOTORITRON. B. S. Dzhelepov and Yu. V. Khol'nov (Khlopin Radium Inst., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 98-105(Jan. 1961). (In Russian)

An attempt was made to improve the efficiency of the magnetic γ spectrometer (the ritron) by expanding its spectral sensitivity to smaller energies. The application of photoelectrons in the spectrometer raised the operational efficiency of the instrument to energies of ~60 kev. The device is capable of measuring energy and relative γ intensities at 60 to 3000 kev with an improved resolving power at small energies and improved photopeak ratio and Compton background. The photoelectron spectra of Tb^{160} obtained with the photoritron are plotted. (R.V.J.)

27809 A METHOD SEPARATING PULSES FROM FAST NEUTRONS AND γ RAYS BY MEANS OF SPACE CHARGE ON PHOTOMULTIPLIERS. G. G. Doroshenko and E. L. Stolyarova. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 152-6(Jan. 1961). (In Russian)

A method is suggested for separating pulses from fast neutrons and γ rays by means of an artificially created space charge on the last cascades of the photomultiplier. The space charge transforms the differences in effective scintillation luminescence into amplitude differences. The amplitude distribution from a Po–Be source shows a distinct discrimination of pulses from fast neutrons and the γ background. (R.V.J.)

27810 OPERATION OF THE FIELD ION MICROSCOPE WITH A DYNAMIC GAS SUPPLY. B. J. Waclawski and E. W. Müller (Pennsylvania State Univ., University Park). J. Appl. Phys., 32: 1472-5(Aug. 1961).

The brightness level of the field ion microscope is increased two orders of magnitude with little loss of resolution by the addition of a dynamic gas supply system. Space charge at the emitter is not a limiting factor. Cathode sputtering by the imaging helium ions may release negative ions which are accelerated toward the tip. These ions gain sufficient kinetic energy so that irrespective of subsequent multiple ionization in the high field region near the tip they are capable of striking the tip surface and cause damage to the tip lattice. This effect can be eliminated by proper electrode design. (auth)

27811 NANOSECOND TRIGGERING OF AIR GAPS WITH INTENSE ULTRAVIOLET LIGHT. Terry F. Godlove (U. S. Naval Research Lab., Washington, D. C.). J. Appl. Phys., 32: 1589-96(Aug. 1961).

Measurements are presented of the breakdown time of a conventional two-electrode air gap. The applied voltage is maintained below the sparking threshold and breakdown is caused by the emission of a 6-nanosec burst of photoelectrons from the cathode, which produces space-charge distortion of the electric field. An auxiliary trigger spark provides the necessary light and results in cathode emission up to ~10 ma/cm^2. The dominant wavelength region is found to be ~1100 A because of the relatively low air absorption and high photoelectric yield in this region. For a fixed gap spacing and using the highest light intensity available, the time delay is typically found to decrease from ~5t_- to a minimum delay t_- as the main gap voltage is increased from ~8% below threshold up to threshold. The minimum delay ranges from 10–60 nanosec for the gap spacings studied and agrees with calculated values of gap spacing/electron drift velocity. The techniques developed have direct application to the triggering of conventional spark-gap switches and to pulsed light sources and may provide an additional tool for investigating some of the basic parameters of gaseous electronics. (auth)

27812 ANODE WIRE EFFECT OF COUNTER TUBES AND ITS APPLICATION. Tatsusaburo Suzuki (Japan Defense Agency). J. At. Energy Soc. Japan, 3: 416-21(June 1961). (In English)

The increase in counting efficiency for γ rays due to the effect of the anode wire of counter tubes is measured by utilization of a collimated γ-ray sheet. The distribution of the number of gamma photons emitted from a slit is measured by means of the effect of anode wire. A divergency of γ rays from a slit is discussed by measuring the distribution of the number of gamma photons (energy 0.662 Mev) at each position from the slit. (auth)

27813 THE PRESSURE IONIZATION CHAMBER FOR DOSE RATE MEASUREMENTS OF LOCAL GAMMA RADIATION. Vladimir Lenger and Vladimir Matousek (Inst. of Industrial Hygiene, Prague). Jaderná energie, 7: 234-8(1961). (In Czech.)

The advantages of using pressurized ionization chambers for local dose rate measurement are outlined, and the design and characteristics of a spherical chamber are described. The sensitivity of the instrument at a nitrogen pressure of 10 atm is 2 ur/h. (auth)

27814 RANGE CURVES OF A NEW NUCLEAR EMULSION AGFA K-2 AND OF NUCLEAR EMULSION NIKFI T-3. Vratislav Havlovic (Charles Univ., Prague). Jaderná energie, 7: 239-41(1961). (In Czech.)

A range curve for protons and alpha particles of energy 0–15 Mev in Agfa K-2 was derived theoretically. Another composition of this emulsion containing less AgBr caused the range of particles to be 10% greater than in the previous composition. Further, the range curve for alpha particles in Agfa K-2 up to energies 8.78 Mev was determined experimentally using ThX, Tn, ThA, and ThC′. Experimental values were compared with the theoretical curve and satisfactory agreement was found. In a similar manner an experimental range curve of alpha particles of energy range 0–8.78 Mev in Nikfi T-3 was determined experimentally. From this range curve a proton range curve was determined by extrapolation. (auth)

27815 DEVELOPMENT OF NUCLEAR AND ISOTOPE-TECHNICAL INSTRUMENTS IN HUNGARY. Kalman Zsdansky (National Bureau of Meteorology, [Hungary]). Meres es Automat., 8: 365-7(1960).

A summary is given of the development and commercial production of nuclear and isotope-technical instruments for physical research. (P.C.H.)

27816 SEMICONDUCTORS YIELD IMPROVED ELECTRON MULTIPLIER. Frederick A. White, James C. Sheffield, and William D. Davis (Knolls Atomic Power Lab., Schenectady, N. Y.). Nucleonics, 19: No. 8, 58-60(Aug. 1961).

The design of a fast, compact, sensitive, and practically noiseless electron multiplier is described. The multiplier has two parallel Si dynodes, and utilizes crossed electric and magnetic fields. At a normal operating temperature of −50°C, a gain on the order of 10^6 is obtained. (T.F.H.)

27817 A DEVICE FOR DIP-ANGLE MEASUREMENT OF TRACKS IN NUCLEAR EMULSIONS. B. Antolković (Inst. "Ruder Bosković." Zagreb). Nuovo cimento (10), 19: Suppl. No. 1, 1-3(1961). (In English)

A device is described by which the dip angle of tracks in photonuclear plates can be measured. The device is an additional part of the microscope but does not require the modification of the microscope itself. (auth)

27818 DETERMINATION OF THE ELECTRIC CHARGE OF A HIGH-CHARGED NUCLEUS OF THE PRIMARY COSMIC RAYS WITH NUCLEAR EMULSIONS. G. Alvial (Universidad de Chile, Santiago). Nuovo cimento (10), 19: Suppl. No. 1, 18-23(1961). (In English)

A new method is described and discussed for studying the heavy primary component of cosmic radiation. It allows the determination of the charge Z, in nuclear emulsions, with a standard error of less than one unit. One relativistic nucleus with a Z as large as 30 was found. (auth)

27819 CHARACTERISTICS OF LIQUIDS FOR USE IN A BUBBLE CHAMBER. R. Kato (Ritumeikan Univ., Kyoto). Nuovo cimento (10), 19: Suppl. No. 1, 30-6(1961). (In English)

The sensitive regions of several liquids in a continuously sensitive bubble chamber are determined. The sensitive regions are discussed on the saturated vapor pressure vs. temperature curves of the liquids used in the chamber. An easily operated expansion chamber was also constructed, which works at low pressure by reducing the pressure in the liquid from pre-expansion pressure of one atmosphere. Some quantitative characteristics of it are given. (auth)

27820 A REMARK ON THE DETECTION OF EVENTS IN NUCLEAR EMULSIONS. C. J. Waddington (Bristol Univ., Eng.). Nuovo cimento (10), 19: Suppl. No. 1, 37-40(1961). (In English)

It is shown that the frequently used method of rescanning to determine the efficiency with which events are detected in the course of a systematic search may under certain conditions lead to seriously misleading conclusions. (auth)

27821 IONIZATION CHAMBER WITH THICK WALLS FOR INTENSITY MEASUREMENTS OF γ-RADIATION AT ENERGIES UP TO 100 Mev. G. Bussetti (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Nuovo cimento (10), 19: Suppl. No. 1, 63-6(1960). (In Italian)

An aluminum thick-walled ionization chamber suitable for measuring the radiation intensity from syncrotrons and betatrons operating at energies up to 100 Mev is described. Curves giving the chamber sensitivity for γ radiation of a given frequency as a function of the current in the chamber are reported. In the calculation the effects of the secondary Compton photons produced in the walls from the incident beam are considered. (auth)

27822 THE RAPID MEASUREMENT OF SPECTRAL INTENSITY WITH AN OSCILLATING FABRY-PEROT SPECTROMETER: ISOTOPE ABUNDANCE IN MERCURY. D. J. Bradley (Univ. of London). Proc. Roy. Soc. (London), 262: 529-40(Aug. 8, 1961).

A high-resolution photoelectric spectrometer employing a mechanically scanned Fabry–Perot interferometer is described. The spectrometer produces high-finesse spectral profiles continuously and rapidly at repetitive frequencies of up to 1000 c/s corresponding to a time resolving limit of 4μs for a scan of 5 orders. The display is on an oscilloscope or a pen-recorder function plotter. The instrument was tested with the high-frequency discharge spectrum of mercury. Single intensity measurements are reproducible to better than 0.5%. The wavelength scale is linear to 0.5% over an order and can be corrected to four times this accuracy. Hyperfine structures agree well with recent determinations which use both pressure scanned and photographic Fabry–Perot systems. The mercury isotope abundances were obtained from the spectral intensity measurements agreeing well with mass spectrometer values. The rms deviation for a single determination is less than 0.5% of the percentage abundance. Possible applications to rapidly varying phenomena in gas discharges and shock waves, the determination of refractive indices and extension to the ultraviolet region for spectroscopy from an earth satellite are briefly considered. (auth)

27823 BASIC CONSIDERATION ON THE METHOD OF COUNTING LOW ENERGY β-PARTICLES WITH LIQUID SCINTILLATION. Hiroshi Kawai (Musashi Inst. of Tech., Japan) and Yasushi Nishiwaki. Radioisotopes (Tokyo), 10: 19-26(Apr. 1961). (In Japanese)

Liquid scintillation detectors with single and duel photomultipliers were investigated and compared. Poor light collection in the detectors led to the design of a new semispherical type vessel made of glass. The spherical part was plated with silver except for the base. All light except for that directed to the base was reflected back toward the base. The counting efficiency of the device was studied for beta particles from C^{14} and H^3. Results were very favorable for C^{14} but somewhat unfavorable for H^3. (L.N.N.)

27824 C^{14} AND H^3 MEASUREMENT WITH USE OF LIQUID SCINTILLATION COUNTERS. Yosihiko Kasida, Mikio Yamazaki, and Tetsuo Iwakura (National Inst. of Radiological Sciences, Chiba, Japan). Radioisotopes (Tokyo), 10: 27-37(Apr. 1961). (In Japanese)

Problems in the measurement of C^{14} and H^3 beta activities were studied by means of liquid scintillation techniques. The influence of container materials on counting efficiency, the importance of determining radioactivities in aqueous solutions, and the effect of fluorescence quenching were investigated. It was found that tritium was more sensitive to fluorescent quenching than C^{14}, and that in the case of a strong quencher, the counting efficiency dropped with its concentration. (L.N.N.)

27825 GAS PHASE COUNTING OF β RAY OF TRITIUM AND ITS APPLICATION TO THE STUDY OF HYDROGEN ADSORPTION ON METAL. Toyosaburo Takeuchi, Masakazu Sakaguchi, and Masaru Tatsushima (Toyama Univ., Japan). Radioisotopes (Tokyo), 10: 106-11(Apr. 1961). (In Japanese)

Gas-phase counting of tritium betas was investigated in the G-M range, using two kinds of counting tube and a filling-gas mixture. The tubes were constructed with tungsten-wire anodes and gold-film cathodes. The effects of tritium partial pressures and counter voltage were observed. No memory effect was found when the gas was evacuated under 10^{-5} mm Hg. It was also found that the counting rate was always reproducible for a given amount of tritium. A distinction between homogeneity and heterogeneity for gas adsorption on reduced nickel powder was investigated by means of tritium tracer. Hydrogen (or tritium) was chemisorbed first on the nickel at 120°C, and tritium (or hydrogen) was subsequently adsorbed, then the gas was taken out and the tritium in the gas was assayed. The results showed that the greater part of the gas adsorbed last was evolved first. The gas adsorbed first was desorbed last only when the temperature of the reaction vessel was raised. Such a phenomenon was emphasized more distinctly when the coverage of gas at the surface on the first admission was small. These results can be explained tentatively by the existence of two types of surface, i.e., strong sites and weak sites. To obtain a decisive conclusion for the heterogeneity, however, the possibility of gas dissolution to the interior of metal must be investigated. (auth)

27826 CsI (Tl) SCINTILLATORS FOR RECORDING α PARTICLES. L. M. Belyaev, A. B. Gil'varg, and V. P. Panova (Inst. of Crystallography, Academy of Sciences, USSR). Soviet Phys.-Cryst., 6: 108-10(July-Aug. 1961).

The preparation, performance, and properties of thallium-activated cesium iodide crystals for recording alpha particles are given. The CsI(Tl) crystals are of large diameter (from 30 to 55 mm) and have good resolving power for the detection, spectrometric measurement, and other work with alpha radiation. For clarification of the performance of the crystals, the spectral resolution of the alpha line of americium-241 is given. The effects of crystal thickness and diameter on luminescence yield are shown. (N.W.R.)

27827 TEMPERATURE RELATIONS OF THE KINKING LIMIT FOR CESIUM IODIDE CRYSTALS. G. V. Berezhkova and V. R. Regel (Inst. of Crystallography, Academy of Sciences, USSR). Soviet Phys.-Cryst., 6: 115-17(July-Aug. 1961).

The characteristics of the compression curves of cesium iodide crystals are given for the temperature range 20 to 600°C and for a constant strain rate of 0.15 mm/min for a cylindrical specimen 2.5 mm in diameter and 5 mm height. The axis of the crystal coincides with the crystallographic directions (100), (110), and at an angle of 20° to the (100). The shape of the compression curves differs for each of the directions; no change is observed for the (100) direction up to 300°, but a change is noticed for the others at about 200°C. The sharp drop in the stress after a certain critical stress is reached is known as the kinking limit. This occurs usually between 20 and 300°C. (N.W.R.)

27828 STUDIES ON THE NUCLEAR EMULSIONS WITH POLYVINYL ALCOHOL (II). THE GAMMA-RAY SENSITIVITY OF THE PVA NUCLEAR EMULSIONS. Etsuo Fujii. Tokyo Kogyo Shikensho Hokoku, 56: 233-40(June 1961). (In Japanese)

Silver bromide emulsion was prepared by using polyvinyl alcohol (PVA) as the protective colloid, and its photographic properties and γ ray sensitivity were studied. The double injector method was used for mixing, and the freezing method used for gel formation of the emulsion which contained 70% silver bromide by weight. The thickness of the emulsion layer was 45μ and its moisture content was 2.8% at a relative humidity of 60%. The plates were exposed to light by use of a sensitometer for obtaining the characteristic curves and also to Co^{60} γ rays, which were best developed at 20°C in 10 minutes with D-11 developer diluted with 3 parts of water. The degree of light sensitivity of the emulsion was the same as that of the low sensitivity type of gelatin emulsion with silver chloride, and its contrast depended upon the temperature at which the precipitation of silver bromide was made. The emulsion can be used for photographic dosimetry of γ rays in the range of 10^3 to 7×10^3 roentgen. In the higher region, blackening of the emulsion increased with the rise of the temperature at which the precipitation of silver bromide was made. The γ ray sensitivity can be increased by hypersensitizing the emulsion with an aqueous solution of triethanolamine, the concentration of which must not exceed 6%, and the time of treatment must not exceed 10 minutes; otherwise, fog increases. When the plate was kept at a relative humidity of 37% at 20 ~ 22°C after irradiation, the degree of the fading of latent γ-ray image was below 10% after 40 days and at a relative humidity of 81%, the degree of fading was about 50% after 4 weeks. The fading was also affected by the radiation dose and was greater in the case of low radiation dose than in the case of high. (P.C.H.)

27829 ABSOLUTE COUNTING OF β-PARTICLES. (THE METHOD OF THE ABSOLUTE SOLID ANGLE AND THE "4 π-COUNTER" METHOD). A. A. Konstantimov. Trudy Vsesoyuz. Nauch. Issledovatel. Inst. Metrol., No. 30, (90), 9-17(1957).

The installation for the absolute counting of β particles by the method of absolute solid angle consists of a brass box

aluminum-coated inside. The detector, a cylindrical counter, has a window closed with a thin (0.04 mg/cm^2) collodion film on its side surface. The source 0.1 mg/cm^2 thick is applied to the collodion film. The box is filled with helium (with an addition of ethyl alcohol vapors) under pressure of 17–20 mm Hg. In the 4 π-counter method two types of installations are used. In the first type the 4 π-counter consists of two cylindrical counters 40 mm in diameter and 80 mm long with the source placed between them. The second-type consists of two semicylinders 80 mm high and 80 mm in diameter with a tungsten filament 0.1 mm in diameter. The source is placed between the semicylinders. The 4 π-counter is placed under a glass hood, evacuated, and filled with the ethyl alcohol (10%) and pure argon (90%) mixture. The measurement error is 2%. The method of weighing radioactive compounds necessary for the absolute counting of β particles is described, and measurement errors of both methods are considered. A comparison of the methods shows that the 4 π-counter method has advantages as compared with the method of absolute solid angle. (Referat. Zhur., Elektrotekh., No. 12, 1959).

27830 PRECISE MEASUREMENTS OF RADIOACTIVE HALF-LIFE. F. M. Karaveev and S. A. Rusinova. Trudy Vsesoyuz. Nauch. Issledovatel. Inst. Metrol., No. 30, (90), 132-42(1957).

Precise measurements of half life by the method of successive measurements and the method of differential ionization chamber are analyzed. A differential chamber installation is described in detail. The convenience of the method of differential chamber for a quick and relatively accurate measurement of half life of long-lived elements is pointed out. Half life values of Na^{24}, Zn^{65}, Cr^{51}, and Ag^{110} are measured. The results obtained are in good agreement with other data. (Referat. Zhur., Electrotekh., No. 12, 1959).

27831 PHYSICAL MEASUREMENTS FROM PHOTOGRAPHS OF PARTICLE TRACES IN BUBBLE CHAMBERS. I. I. Pershin. Uspekhi Fiz. Nauk, 73: 559-81(Mar. 1961). (In Russian)

Comparative characteristics of various chambers and photoemulsions, the operating properties of liquids used in bubble chambers, and the range of μ-mesons, π-mesons, K-mesons and protons at energies of 5 to 1000 mev in various bubble chambers are summarized. The methods of calculating the spatial location of particle tracks from the coordinates measured on a film are presented. In determining the velocity of high-energy particles, it is essential that the final pressure and temperature be kept constant so that relation between velocity and number of bubbles per 1 cm length of track can be used to determine the velocity. The effect of overlapping of the bubbles in determining the average density of the bubbles is discussed. The velocity of the particle can be found from the number of δ-electrons observed along the particle track. The error from multiple scattering in measuring the momentum of a particle in a bubble chamber placed in a magnetic field is discussed. Methods of determining the "scattering constant", and the determination of the momentum by measuring the curvature of a trace due to the combined effect of a magnetic field and multiple scattering are given. The use of semi-automatic devices for measuring the coordinates of photographed particle tracks, and transformation of the measured values for computer use is mentioned briefly. (74 references). (TTT)

27832 MASS SPECTROMETER FOR LIGHT ELEMENTS. Bonnet (Compagnie Francais Thomson-Houston, Bagneux (Seine) [France]). Vide, 16: No. 93, 134-42(May-June 1961).

A description of a mass spectrometer, with interchangeable elements permitting its adaptation to many kinds of analysis, is given. Double collection analysis with permanent magnet, or single collection with electrostatic or electromagnetic sweeping is possible. Specialized variant for analysis of hydrogen–deuterium mixtures permitting concentration measurements in atomic deuterium in hydrogen between 0 and 10^4 ppm is discussed. Variant for analysis of solids in solution is described. (auth)

27833 QUANTUM COUNTERS. A. M. Prokhorov (Lebedev Inst. of Physics, [Moscow]). Zhur. Eksptl'. i Teoret. Fiz., 40: 1384-6(May 1961). (In Russian)

Noise in quantum counters is examined and the transient time in the counters is estimated. (auth)

27834 A POCKET DOSIMETER WITH RADIATION ELEMENT. (to Licentia Patent-Verwaltungs-G.m.b.H.). British Patent 873,911. Aug. 2, 1961.

A pocket dosimeter for the detection of gamma rays, neutrons, and x-rays is described. The dosimeter consists of two hollow concentric spheres, coaxial prisms, or cylinders, one surrounded by the other. These chambers are insulated from one another and have different electron-emitting capacity so as to produce an electromotive force when subjected to radiation, thus forming electrodes of a voltage cell. An electrometer is connected to this cell so as to measure the electromotive force produced. (N.W.R.)

27835 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR INDICATING THE METAL OXIDE CONTENT OF A LIQUID METAL. Leslie Reginald Blake (to United Kingdom Atomic Energy Authority). British Patent 873,912 Aug. 2, 1961.

An apparatus is described for measuring small changes in the electrical resistivity of a liquid metal due to the presence of metal oxide, impurities, or gas bubbles. The device consists of electrodes which cause the passage of an alternating current through the liquid metal in a metal pipe included in the pipework. There are probes for deriving two voltages, one being that due to the current through the liquid metal in the pipe and the other being a reference voltage which is derived from a sealed tube containing the same liquid metal but having a fixed oxide, impurity, and gas bubble content. (N.W.R.)

27836 IMPROVEMENTS IN OR RELATING TO RADIATION PYROMETERS. Donald Geoffrey Avery and Colin David Reid (to United Kingdom Atomic Energy Authority). British Patent 874,000. Aug. 2, 1961.

A radiation pyrometer is described that is suitable for measuring the surface temperature of metal bars in passage through a narrow zone between a heating zone and a quenching zone at temperatures in the range 650 to 750°C. The pyrometer consists of a rod of material capable of transmitting radiation over the wavelength interval λ_1 to λ_3. The rod has breaks for the first and second radiation choppers, and has a shaped radiation receiving end for partly encircling the radiation source. The radiation transmission path has a radiation receiving end for positioning adjacent to a radiation source, a photocell at the other end for receiving the transmitted radiation, a first radiation chopper in the path having wavelength transmission intervals λ_1 to λ_2 and λ_2 to λ_3, where λ_2 lies between λ_1 and λ_3, so that the photocell receives alternate signals related to the transmission intervals λ_1 to λ_2 and λ_2 to λ_3 respectively. A second radiation chopper in the path provides a carrier signal for the alternate signals and means for determining the ratio of amplitude of the alternate signals. (N.W.R.)

27837 IMPROVEMENTS IN ELECTRIC OVERVOLTAGE DISCHARGE DEVICE. (to General Electric Co.). British Patent 874,215. Aug. 2, 1961.

An electric overvoltage discharge device is described that is stable and reliable in operation over a long period. The device contains an envelope which includes an elongated hollow insulator bonded to the rim of a bottle-like metallic member. An elongated metal electrode support member extends concentrically through the hollow insulator and is spaced from the bottom of the bottle-like member to form a gap. The bottom of the bottle-like member is indented in the center to form an electrode. The gap is the greatest region of field concentration between the opposing metal surfaces. An inert ionizable medium is within the envelope at a pressure of 0.01 to 2500 mm of Hg, and radioactive means (nickel-63 and krypton-85) are contained in the envelope for maintaining ionization at a predetermined level lower than the normal level of ionization upon discharge of the gap. (N.W.R.)

27838 IMPROVEMENTS IN OR RELATING TO POSITION INDICATORS WITH A DIAL. Ronald Bellinger and William Henry Shipley (to Strachan & Henshaw, Ltd.). British Patent 874,224. Aug. 2, 1961.

A position indicating device with a dial is described. The device may be used for actuating the radiusing and turning or orientation of a chute relative to several selected channels of a heterogeneous reactor. Thus the device indicates the relative position of two actuating members movable relative to each other and to a fixed member since it is coupled to each actuating member and associated with a common chart. The bearing marks identify a number of selected positions relative to the fixed point. Thus when the indicators are in register with each other and any selected index mark a selected positioning is obtained. (N.W.R.)

27839 IMPROVEMENTS IN OR RELATING TO EQUIPMENT FOR MONITORING RADIOACTIVITY IN LIQUIDS. Kenneth William Cunningham and Denis Aliaga Kelley (to Plessey Co., Ltd.). British Patent 876,237. Aug. 30, 1961.

An apparatus is designed for continuously monitoring the activity in a liquid, using a sample vessel of constant geometry and a periodic automatic purging to remove surface contamination from the detector and the sample vessel. The sample vessel has an uppermost opening which functions as a weir to ensure a constant liquid level, and a timing mechanism is provided to periodically shut off the radioactive liquid supply and flush the sample vessel with clean water. (D.L.C.)

27840 APPARATUS FOR MEASURING THE TOTAL ACTIVITY DISCHARGED FROM A RADIOACTIVE FLUID DISPOSAL PLANT. George Donald Smith and Alan Clark Cross (to Plessey Co. Ltd.). British Patent 876,238. Aug. 30, 1961.

An apparatus for measuring radioactivity discharged from disposal plants is described which provides a pulsed output. The output has a pulse repetition rate proportional to the activity per unit volume or area of the material and is gated for periods proportional to the flow rate of the material. The gating circuit is interposed between the detector and the scaling and registering systems, and is activated by a gating pulse generator whose pulse duration is determined by the d-c input voltage from a flow rate measuring device. (D.L.C.)

27841 ELECTRICAL LOAD ANTICIPATOR AND RECORDER. John E. Werme (to U. S. Atomic Energy Commission). U. S. Patent 2,998,917. Sept. 5, 1961.

A system is described in which an indication of the prevailing energy consumption in an electrical power metering system and a projected power demand for one demand interval is provided at selected increments of time within the demand interval. Each watt-hour meter in the system is provided with an impulse generator that generates two impulses for each revolution of the meter disc. In each demand interval, for example, one half-hour, of the metering system, the total impulses received from all of the meters are continuously totaled for each 5-minute interval and multiplied by a number from 6 to 1 depending upon which 5-minute interval the impulses were received. This value is added to the total pulses received in the intervals preceding the current 5-minute interval within the half-hour demand interval to thereby provide an indication of the projected power demand every 5 minutes in the demand interval.

27842 LINEAR COUNT-RATE METER. John J. Henry (to U. S. Atomic Energy Commission). U. S. Patent 2,999,168. Sept. 5, 1961.

A linear count-rate meter is designed to provide a highly linear output while receiving counting rates from one cycle per second to 100,000 cycles per second. Input pulses enter a linear discriminator and then are fed to a trigger circuit which produces positive pulses of uniform width and amplitude. The trigger circuit is connected to a one-shot multivibrator. The multivibrator output pulses have a selected width. Feedback means are provided for preventing transistor saturation in the multivibrator which improves the rise and decay times of the output pulses. The multivibrator is connected to a diode-switched, constant current metering circuit. A selected constant current is switched to an averaging circuit for each pulse received, and for a time determined by the received pulse width. The average output meter current is proportional to the product of the counting rate, the constant current, and the multivibrator output pulse width.

27843 DIFFERENTIAL FAULT SENSING CIRCUIT. Joseph H. Roberts (to U. S. Atomic Energy Commission). U. S. Patent 2,999,187. Sept. 5, 1961.

A differential fault sensing circuit is designed for detecting arcing in high-voltage vacuum tubes arranged in parallel. A circuit is provided which senses differences in voltages appearing between corresponding elements likely to fault. Sensitivity of the circuit is adjusted to some level above which arcing will cause detectable differences in voltage. For particular corresponding elements, a group of pulse transformers are connected in parallel with diodes connected across the secondaries thereof so that only voltage excursions are transmitted to a thyratron which is biased to the sensitivity level mentioned.

27844 METHOD AND APPARATUS FOR METABOLIC ASSAY. Bert M. Tolbert, M. R. Kirk, and E. M. Baker (to U. S. Atomic Energy Commission). U. S. Patent 3,000,377. Sept. 19, 1961.

A method and instrumentation are described for producing an instantaneous and continuous curve of the rate at which any selected carbon-containing substance is metabolized by a living subject. The substance is prepared with a known proportion of C^{14} and, after administration, the C^{14} content of the subject's exhalations is continuously monitored along with the total CO_2 content thereof. The resulting data are continuously compared and displayed in graphical form to give the desired metabolic information. The invention includes specialized radiation counting means as well as means for assuring exact synchronization of the C^{14} and CO_2 signals.

27845 DIRECT COUPLED AMPLIFIER. R. A. Dandl (to U. S. Atomic Energy Commission). U. S. Patent 3,001,144. Sept. 19, 1961.

A transistor amplifier is designed for very small currents below 10^{-8} amperes. The first and second amplifier stages use unusual selected transistors in which the current amplification increases markedly for values of base current below 10^{-6} amperes.

27846 OPTICAL TRANSCRIBING OSCILLOSCOPE. Quentin A. Kerns (to U. S. Atomic Energy Commission). U. S. Patent 3,001,847. Sept. 26, 1961.

A device is designed for producing accurate graphed waveforms of very fast electronic pulses. The fast pulse is slowly tracked on a cathode ray tube and a pair of photomultiplier tubes, exposed to the pulse trace, view separate vertical portions thereof at each side of a fixed horizontal reference. Each phototube produces an output signal indicative of vertical movement of the exposed trace, which simultaneous signals are compared in a difference amplifier. The amplifier produces a difference signal which, when applied to the cathode ray tube, maintains the trace on the reference. A graphic recorder receives the amplified difference signal at an x-axis input, while a y-axis input is synchronized with the tracking time of the cathode ray tube and therefore graphs the enlarged waveshape.

Materials Testing

27847 (DTMB-1065) ANALYSIS FOR DETERMINING STRESSES IN STIFFENED CYLINDRICAL SHELLS NEAR STRUCTURAL DISCONTINUITIES. Robert D. Short and Robert Bart (David Taylor Model Basin. Structural Mechanics Lab., Carderock, Md.). June 1959. 25p.

Recent developments in structural research on circular ring-stiffened cylinders subjected to hydrostatic pressure indicated that refinements of the standard strength analysis are required to account for the effects of discontinuities such as a heavy frame or bulkhead or variations in shell thickness. A procedure was developed for computating axisymmetric stresses near these discontinuities in a cylinder in which the thickness of the material does not vary between a pair of stiffeners but may change from one side of a stiffener to the other. The results of this analysis indicate that stresses higher than those predicted by a standard computation will usually exist near these discontinuities. A method of reducing this effect by modifying the geometry near these points is also presented. (auth)

27848 (GA-2067) METALLOGRAPHY OF CARBIDE FUEL COMPOUNDS. G. B. Engle, F. D. Carpenter, W. V. Goeddel, and D. L. Menken (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Mar. 14, 1961. Contract AT(04-3)-314. 25p.

New metallographic techniques were developed for handling and examining thorium carbide-containing carbides. The grain structures of ThC, (Th,U)C, ThC_2, $(Th,U)C_2$, UC, UC_2, and carbon-coated carbide particles are shown. (D.L.C.)

27849 (NP-9496) INVESTIGATION OF CRITERIA FOR SELECTING STRUCTURAL METALS. Final Report. Civil Engineering Studies Structural Research Series No. 202. R. J. Mosborg and N. M. Newmark (Illinois. Univ., Urbana). June 1960. Contract N6-ori-71. 178p.

The investigation included studies of the general behavior of structural materials when subjected to various types of static, impact, and fatigue tests. Studies described are: notched-specimen static tests; axial tension-impact tests; repeated-impact and impact-fatigue tests; cumulative damage in fatigue; strength under repeated axial compression and tension; upper and lower yield points of structural steels; metallurgical and mechanical properties of steel rivets; and instrumentation and techniques. The results of these tests, in addition to the usual mechanical properties, are of use in evaluating materials for structural purposes. (B.O.G.)

27850 (SCTM-142-61(71)) FLEXURAL CHARACTERISTICS OF RADIALLY LOADED CYLINDRICAL SHELLS WITH STIFFENING RINGS. D. R. Fisher (Sandia Corp., Albuquerque, N. Mex.). Aug. 1961. 30p.

Cylindrical shells with stiffening rings were tested in order to verify the validity of existing methods of analysis for shells of this type. The results indicate that skin strains caused by ring bending, neglected in the analytic methods, are noticeable five inches away from the ring centerline. Calculations of ring stresses with a three-inch effective skin width yield the best agreement between the experimental and theoretical results. (D.L.C.)

27851 (TID-13388) STRAIN DISTRIBUTION IN A THIN CIRCULAR DISK. F. H. Mathews and R. Dove (New Mexico. Univ., Albuquerque). July 1, 1961. For Sandia Corp. 50p. (SCDC-2382)

The imbedded gage technique was used to study strain distribution in three-dimensional models of piezoelectric ceramic elements. Both static and dynamic forms of loading were used. A study was first made of the similarity between the model and the ceramic disk. Equations and methods for reducing strain gage readings to principal strain magnitudes and directions were worked out. The construction and testing of the final model are described. An analysis of the test results and a discussion of the results are included. Results are shown on graphs. (M.C.G.)

27852 (WAL-TR-830.5/2) DETERMINATION OF FLAW GEOMETRY BY ULTRASONIC PULSE CONTOUR AND SPECTRUM ANALYSIS. John J. Maguire (Watertown Arsenal Labs., Mass.). July 1961. 14p.

The application of ultrasonic pulses of almost rectangular envelope to pulse-echo testing, resulting in the simultaneous transmission of a wide band of ultrasonic frequencies are described. In comparison with the essentially monochromatic ultra-sound used in conventional test systems, this method permits the derivation of additional information from the test, obtained in the form of the spectral energy distribution after reflection from the defect. Besides determining the location of a flaw, it is now possible to gather data representing the flaw geometry. (auth)

27853 (AEC-tr-4512) MAGNETIC METHODS OF FLAW DETECTION (NONDESTRUCTIVE TESTING), ANALYSIS AND MEASUREMENTS. Collection of Scientific and Technical Reports of the Conference held in Sverdlovsk in October 1956. R. I. Yanus and N. M. Rodigin, eds. Translated from Trudy Instituta Fiziki Metallov, Akademiya Nauk S.S.S.R., Ural'skii Filial, No. 21 (1959). 411p.

Reports presented at a conference concerning the theory and technology of magnetic flaw detection, thickness detection, and structural analyses are compiled. Other papers on the theory and technology of iron-probing apparatuses used for magnetic measurements and magnetic flaw detection are also described. A number of new problems requiring further study are discussed. (J.R.D.)

27854 STUDIES ON THE INSPECTION METHODS OF SMALL-SIZED STAINLESS STEEL TUBES FOR FUEL CLADDING. Shiro Mochizuki (Mitsubishi Atomic Power Ind., Inc., [Japan]), Tatsuo Maekawa, Michio Mizuta, Shozo Iwai, Sachio Maeda, and Akira Murakami. J. At. Energy Soc. Japan, 3: 430-9(June 1961). (In Japanese)

As a part of the series of manufacturing studies of fuel rods using UO_2 pellets with stainless steel cladding, some inspection methods for the tubes were developed. To measure the outside and inside diameters, the air micrometer apparatus was applied. Eddy current instruments for nondestructive testing were applied to check the material integrity, and moreover, by hydrostatic test at high temperature, the pressure-resistant properties of tubes were ascertained for internal and external pressure. The applied methods and results measured by them are described. The specimens, the material of which was AISI type 304 L stainless steel and the size of which was 8.56 mm O.D. and 7.50 mm I.D., were supplied by four tube manufacturers. Three of them were Japanese and one was from the USA. The results of the investigation indicate that some Japanese tubes are comparable to the reactor grade U. S. tube. (auth)

27855 TESTING IRRADIATED FUEL AT HANFORD. John M. Fouts (General Electric Co., Richland, Wash.). Nucleonics, 19: No. 8, 64-5(Aug. 1961). (HW-SA-1743)

Post-irradiation studies of test fuel elements are described. The corrosion is studied by visual and weight analysis; the bond integrity by ultrasonic pulse-echo techniques; and the dimensional stability by optical profilometer measurements. (T.F.H.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

27856 (NASA-TN-D-705) CONTRIBUTIONS OF ROCKETS AND SATELLITES TO THE WORLD MAGNETIC SURVEY. J. P. Heppner, T. L. Skillman, and J. C. Cain (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Sept. 1961. 12p.

Mapping of the earth's magnetic field with satellites is of primary importance in the World Magnetic Survey. This importance stems not only from the operational capability to map vast regions in minimum time, but also from the capability to differentiate the causes of variations in the earth's field. Rocket and space probe measurements supplement satellite surveys in providing crossties for mapping and in finding the sources of field variations. For most of the survey objectives, highly accurate measurements are required. Thus, magnetometers based on nuclear or atomic resonance offer many advantages. Vanguard III (1959η), with a proton precessional magnetometer, was an initial step toward field mapping with an absolute instrument. Optical pumping magnetometers now make possible continuous absolute measurements over the full range of earth field intensities with low power dissipation. The Orbiting Geophysical Observatory satellites will probably be the primary vehicles for future magnetic field surveys. These include satellites in highly eccentric orbits with small inclination and satellites in polar orbits of low eccentricity. (auth)

27857 (NP-10556) DEPARTMENT OF MINING AND METALLURGY, UNIVERSITY OF BRITISH COLUMBIA, PROGRESS REPORT NO. 2. (British Columbia. Univ., Vancouver). May 1961. 60p.

Progress in the development of semiconductor uses for uranium is described. An up-to-date card reference system was established. Experimental work on semiconductor uses was widened to include an examination of uranium-containing compounds other than the oxide. Work was performed on the use of uranium as a catalyst for the ammonia synthesis and as a potential additive to basic refractories such as MgO. Methods of preparing uranium compounds for this study are discussed. Cold compaction followed by a high temperature sinter, hot or reaction pressing, direct growth of massive crystals, and explosive compacting were all used in the fabrication of uranium compounds to determine the best method for their use as semiconductors. Descriptions are given of the experimental work on the determination of electrical conductivity and gathering of x-ray diffraction data on MgO doped UO_2 samples. Possible methods of measuring thermal conductivity are also discussed. (M.C.G.)

27858 (NP-10563) THE SIGNIFICANCE OF RADIATION MEASUREMENTS BY SATELLITES FOR METEOROLOGY. Third Special, Technical and Scientific Report. H. Faust (Germany. Deutsche Wetterdienst, Offenbach am Main). Aug. 1, 1960. Contract DA-91-591-EUC 1295 (OI-4152-60). 12p.

The effect of the layers of maximum and minimum wind on the dynamics of the atmosphere was investigated. The null layer effect was found to intensify pressure gradients in the statistical mean. Results indicated that the different heating of the earth's surface builds up the null layer. The dynamic processes in the region above 20 km are discussed. In large scale weather research, statistical investigations were carried out to determine the influence of solar ultraviolet eruptions on the weather processes. The use of satellites and rocket measurements of solar radiation is discussed. (M.C.G.)

27859 (ORO-449) THE SEDIMENTATION OF MANGANESE IN THE OPEN OCEAN. Final Report. Peter J. Wangersky (Miami. Univ., Coral Gables, Fla.). June 1961. Contract AT(40-1)-2735. 4p.

The sedimentation of manganese in the open ocean is discussed. The acetate buffer separation technique was applied to 6 cores, 3 from the Atlantic Ocean near the equator and 3 from the Caribbean Sea. The manganese distribution in the soluble fraction followed a consistent pattern, a very low concentration of soluble manganese in the surface layers followed by a linear increase with depth. Only one core showed a linear decrease with depth. Calcium, magnesium, and strontium concentrations were also determined. All of the cores examined showed a constant linear decrease in insoluble manganese with depth. (M.C.G.)

27860 (RME-4527(Rev.)) RECONNAISSANCE FOR URANIUM IN THE ELQUI-VICUÑA AREA, PROVINCE OF COQUIMBO, CHILE. William A. Bowes, Paul H. Knowles, Mario Serrano C., and Erik Klohn H. (Division of Raw Materials, AEC and Chile. Instituto de Investigaciones Geologicas, Santiago). Sept. 1958. 12p.

The Elqui-Vicuña area, Coquimbo province, Chile, was selected for U reconnaissance on the basis of two known U occurrences and favorable area-wide geologic indications of the possible presence of U in commercial quantities. The general geology of the area was noted, and selected localities and mining districts were visited. The level of radioactivity is low, and no rock units having anomalous radioactivity were found. Favorable U host sandstones with disseminated Cu minerals seem to be devoid of radioactivity and, in general, little anomalous radioactivity is associated with mineral deposits. The maximum radioactivity noted outside the known U occurrences was 0.03 mr/hr, approximately two times background. The U deposits of Tambillos are low grade and narrow and should be considered for further work only in the event that no potentially commercial deposits are found elsewhere in the course of these studies. Our preliminary investigation suggests that the Elqui-Vicuña area probably has a low U potential and is unlikely to warrant much additional investigation. (auth)

27861 (RME-4534(Rev.)) RECONNAISSANCE FOR URANIUM IN THE TOCOPILLA AREA, PROVINCE OF ANTOFAGASTA, CHILE. William A. Bowes, Paul H. Knowles, Mario Serrano C., and Rudolfo Gruenwald S. (Division of Raw Materials, AEC and Chile. Instituto de Investigaciones Geologicas, Santiago). Feb. 1959. 13p.

In September–October 1958 a six-day reconnaissance in the Tocopilla area, Antofagasta Province, Chile, was made to evaluate reported U occurrences. U occurs near Tocopilla in east- to northeast-trending tensional fractures associated with quartz, actinolite, and Cu and Fe minerals in veins paralleling andesite dikes. The dioritic to syenitic host rock is part of the Tocopilla pluton. The highest radiometric assays from veins were 0.09% equivalent U. In view of the persistence and character of the northeast-trending tensional structures, a limited program of more detailed geologic mapping seems warranted. (auth)

27862 (TEI-792) LITHOLOGIC LOGS OF THREE EXPLORATION CORE HOLES, U15b AREA, CLIMAX

STOCK, NEVADA TEST SITE, NYE COUNTY, NEVADA. F. N. Houser (Geological Survey, Washington, D. C.). Aug. 1961. 71p.

Three core holes were drilled in the Climax stock to determine the nature of the igneous rock to depths of 1,800 feet. Granodiorite was penetrated throughout all three holes except locally where inclusions and probable inclusions of quartz diorite as much as 34 feet thick were encountered. Textural variations of the granodiorite in the lower part of one hole suggested a possible nearby intrusive contact. Fractures were common in all holes and ranged from a hairline to tens of feet in width; their frequency decreases with depth. (auth)

27863 (TID-13376) AN INVESTIGATION OF TRITIUM IN ATMOSPHERIC MOISTURE, RAINWATER AND THE SEA IN THE EUROPEAN AREA. Annual Progress Report. Bert Bolin (Stockholm. Univ.). July 1, 1961. Contract AT(30-1)-2458. 57p.

A hydrogen gas counting system was developed for the determination of tritium in natural water. An electrolysis cell for the electrolytic enrichment of tritium and deuterium for natural tritium measurements is described. Tritium measurements made in precipitation in Stockholm are given. Preliminary geophysical interpretations of these measurements are discussed. The present sampling program is outlined. (M.C.G.)

27864 (AEC-tr-4484) STRONTIUM-90 FALLOUT IN THE USSR. V. M. Shubko (Akademiya Nauk S.S.S.R.). Translation of United Nations report A/AC.82/G/L.330. 1959. 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 14952.

27865 (AEC-tr-4618) THE USE OF RADIOISOTOPES IN PRACTICAL GEOLOGY. Immo Wendt. Translated from Kerntechnik, 2: 1-9(1960). 22p.

The uses of radioisotopes in various fields of geology are described. The following subjects are stressed in particular: the radioactive measuring techniques in deep bore-holes (the gamma log and neutron log), the absorption and scattering measurement techniques in which the soil density is determined by a gamma log and the moisture content is determined by a neutron source, and the use of tracer experiments in hydrology for evaluating water requirements and for application to the mining industry. (auth)

27866 (CEA-tr-A-925) DISPOSITIF D'EXPLORATION DE FORMATIONS TRAVERSÉES PAR UN SONDAGE A L'AIDE D'UNE SOURCE DE NEUTRONS MONOÉNERGÉTIQUES. (Equipment for Exploration of Formations with Boring Aided by a Source of Monoenergetic Neutrons). G. Schlumberger. Translated into French by R. Carbonnier from German Patent No. 1052591. Mar. 6, 1961. 48p.

A device formed of a casing resistant to pressure and which can be introduced into the bore hole is used for the exploration of ground formations crossed by a bore hole. A neutron source and a detector are used to produce and study nuclear reactions from which the nature of the ground formation is deduced. The specifications for a neutron source with controllable flux to be used in such explorations are given. (J.S.R.)

27867 (CEA-tr-X-391) INFLUENCE DES SUBSTANCES ORGANIQUES SUR LE CYCLE GEOCHIMIQUE DE L'URANIUM. (Influence of Organic Substances on the Geochemical Cycle of Uranium). A. Jeczalik. Translated into French from Przeglad Geol., 7: 216-21(1959). 36p.

The actual state of knowledge on the effects of organic substances in the geological conditions of uranium concentration is reviewed in some detail. An attempt is made to clarify the geochemical mechanism of this concentration. (J.S.R.)

27868 THE METHOD OF DIMENSIONS IN SOLVING PARTICLE-TRANSFER PROBLEMS. Sh. A. Guberman. Atomnaya Energ., 10: 369-71(Apr. 1961). (In Russian)

Principles of similitude are applied in resolving various problems in neutron and γ distribution in rocks, in determining the density of ice and snow by γ attenuation, and in other nuclear geophysics problems. (R.V.J.)

27869 THE SCALE FACTOR FOR USE IN QUANTITATIVE INTERPRETATIONS OF GAMMA-GAMMA LOGS. A. M. Lebedev, S. G. Troitskii, and V. L. Shashkin. Atomnaya Energ., 10: 394-6(Apr. 1961). (In Russian)

Various gas-discharge and scintillation counter data were used for quantitatively evaluating the γ-emission factor in logging various infinite layers (the infinite layer is taken as μr/hour per 0.01% of uranium or thorium). (R.V.J.)

27870 THE SPATIAL AND ENERGY DISTRIBUTIONS OF THE NEUTRONS IN A STRATUM CONTAINING A BOREHOLE. O. A. Barsukov and V. S. Avzyanov. Atomnaya Energ., 10: 478-86(May 1961). (In Russian)

Analytical and experimental results are given of the spatial-energy distribution of neutrons in limestone intersected by a borehole. Differential equations describing neutron reactions with the medium are reduced to finite-differential equations. Comparisons are made of the theoretical and experimental data. (tr-auth)

27871 DETERMINATION OF TRACES OF URANIUM, THORIUM, AND POTASSIUM IN ROCKS BY MEANS OF γ-RAY SPECTRA. N. P. Kartashov. Atomnaya Energ., 10: 531-3(May 1961). (In Russian)

A method of separate γ spectrometric determination of small quantities of potassium and equilibrium U and Th homogeneously distributed in rocks is described. (R.V.J.)

27872 THE EFFECT OF THE SPECIFIC WEIGHT OF URANIUM ORES AND OF THE ABSORBING IRON LAYER ON THE SCINTILLATION SPECTRUM OF THEIR γ-RADIATION. A. G. Grammakov, A. K. Ovchinnikov, Yu. P. Lyubavin V. M. Ovchinnikov, and A. M. Sazonov. Atomnaya Energ., 11: 69-71(July 1961). (In Russian)

Mockups consisting of Fe containers filled with U ores were used for investigating the dependence of the energy spectrum on the specific weight of the ores. The differential spectra of the γ-radiation showed a shift of the soft portion of the radiation toward the low-energy region as the weight of the ore in the mockups decreased. The shapes of the curves were quite similar. In the case of the integral spectra the absorption curves did not differ by more than $\pm 6\%$ for the different energy regions, indicating that the core sampling error is in the same order of magnitude. In order to compare logging data obtained with different casings, the correction factor for the absorption of γ-radiation by the Fe wall must be known. On the basis of the tests it is found necessary to determine the exact location of the level of discrimination, otherwise the γ-anomalies cannot be interpreted quantitatively. (TTT)

27873 APPRAISEMENT OF THE EFFECT OF NEUTRON RESONANCE CAPTURE IN ROCKS. I. A. Kozachok (Inst. of Geology, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R., No. 5, 631-5(1961). (In Ukrainian)

On the basis of a previous theoretical study, the effect

of neutron resonance capture is appraised. It is considered for the case of a point monoenergetic source in an infinite stratum. The decrease in neutron slowing density beyond the resonance region, due to resonance capture, may be considerable. The considered effect may be utilized for the detection and quantitative estimation of some heavy elements in borehole cross sections. (auth)

27874 THE USE OF NEUTRON METHODS IN THE GEOCHEMICAL EXPLORATION AND ANALYSIS OF BORON DEPOSITS. V. F. Ivanova and F. F. Kirnozov (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 7, 604-9(1961). (In Russian)

A 1.5-curie Po-Be source furnishes fast neutrons which are used to irradiate the surrounding medium in a borehole. The decrease in the count of the secondary gamma radiation or of the thermal neutron flux gives an accurate indication of the B_2O_3 content in the rock up to about 2-3% B_2O_3. For higher boron contents in the rock it is necessary to surround the neutron counter with a cadmium-paraffin filter, and count the epithermal neutron flux in order to determine a content of B_2O_3 of up to 15% in the rock. The 1-mm Cd filter absorbs almost all the thermal neutrons, but transmits the epithermal neutrons which are slowed down by the backing paraffin layer and counted by the neutron counter. It was found that the epithermal neutron count is inversely proportional to the B_2O_3 content in the rock. This method can be used to detect boron deposits containing up to 15% B_2O_3 in a bore hole. (TTT)

27875 SEISMIC METHOD OF DETECTING AND IDENTIFYING NUCLEAR EXPLOSIONS. I. P. Pasechnik (Inst. of Geophysics, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 6, 835-46(June 1961). (In Russian)

Quantitative characteristics are given for the noise level of very quiet, mean, and noisy stations. Parameters of seismic apparatus suggested during the Conference of 1958–1959 are discussed. (R.V.J.)

27876 ON THE THEORY OF NEUTRON WELL LOGGING USING NEUTRON PULSE GENERATOR. V. F. Zakharchenko (Inst. of Geophysics, Ural Branch, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 6, 847-54(June 1961). (In Russian)

Non-steady neutron transport is analyzed. Synthetic scattering functions are used in developing differential equations for diffusion approximation in water bearing moderator. Time-energy distribution is found and analyzed. The expression and graphs are given for the mean moderating time. Narrow and wide neutron pulses are discussed from the standpoint of their application in well logging practice. (tr-auth)

27877 EFFECTS OF SILICON ACTIVATION BY FAST NEUTRONS ON THE ACTIVATION LOGGING OF BAUXITE DEPOSITS. V. A. Belykh, I. N. Sen'ko-Bulatnyi, S. A. Shulyat'ev, and L. I. Yakub (Inst. of Geophysics, Ural Branch, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 6, 917-21(June 1961). (In Russian)

In logging (with PO–Be neutron source) rock containing Al_2O and SiO_2, the integral γ field intensity resulting from the decay of Al^{28} produced by $Al^{27}(n,\gamma)$ and $Si^{28}(n,p)$ reactions is measured. Fast neutron silicon activation is more efficient in dry, silicon rich rock. (R.V.J.)

27878 OGUNI-KANAMARU URANIUM DEPOSITS IN THE UETSU MASSIF REGION, NORTHEAST JAPAN. Osao Kadota, Motoo Sato, Fumio Togo, and Eizo Nakamura (Atomic Fuel Corp., Tokyo). J. At. Energy Soc. Japan, 3: 422-9(June 1961). (In Japanese)

Several uranium deposits of the sedimentary type were found in the Neogene Tertiary sediments of Uetsu Massif in Northeast Japan. Most of them, except the Oguni-Kanamaru deposits around the border of Niigata and Yamagata Pref., were not so fully explored as to offer any information about their geological significance. There are two types of uranium deposits in the Oguni-Kanamaru area, those in conglomerate and those in arkose. The latter type deposits are tabular in form and more extensive and uniform in grade than the former. It may be inferred from their mode of occurrence and the texture of ore that the tabular deposits in arkose belong to the water table type. (auth)

27879 GROSS BETA-ACTIVITY IN THE THAMES RIVER (CONN.). D. M. Skauen, T. Hatfield, D. Hanlon, and J. S. Rankin, Jr. (Univ. of Connecticut. Marine Research Lab., Noank). Nature, 191: 1017(Sept. 2, 1961).

Radioassays were conducted on oysters, clams, mussels, and algae. Maximum levels of radioactivity occurred in January 1961, in Laminaria (algae) with a total of 356 $\mu\mu$c/gm of ash. Minimum values recorded during the year were in oysters in December 1960, with 23 $\mu\mu$c/gm of ash. On the basis of analyses for total potassium in the organisms, it was determined that most of the β activity observed was due to potassium-40. It was concluded that the quantity of radioactivity present in marine organisms studied is extremely small and does not represent a health hazard. (P.C.H.)

27880 BULLETIN OF THE ATMOSPHERIC RADIOACTIVITY. NUMBER 23, OCTOBER-DECEMBER 1960. Tokyo, The Japan Meteorological Agency, 1961. 93p. (In English and Japanese)

Data are tabulated on the radioactivity in samples of rain water and dusts collected at a number of stations located throughout Japan during October, November, and December, 1960. Data are included on measurements of U_3O_8 standard samples at each station. (C.H.)

27881 METEOROLOGISCHE EINFLÜSSE AUF RADIOAKTIVE BEIMENGUNGEN IN DER ATMOSPHÄRE. (Meteorological Influences on Radioactive Impurities in the Atmosphere). M. Hinzpeter and H. K. Meyer. No. 16 of "Schriftenreihe des Bundesministers für Atomkernenergie und Wasserwirtschaft. Strahlenschutz." Munich, Gersbach & Sohn Verlag, 1961. 76p. DM 5.

The presence and behavior of radioactive particles in the atmosphere are discussed. Topics covered include the cycle of natural radioactivity in the air; the behavior of artificial radioactive impurities; experimental facts about common aerosols; the daily, weekly, and yearly course of aerosols; periodic behavior of the ratios of single nuclides; age determinations according to Hunter and Ballou; the ratio of Cs^{137} to Sr^{90} in the air at 15 to 19.5 and 24 to 27 km as well as at sea level; the ozone layer and turbulence; synoptic weather conditions and artificial radioactivity in the air; weather conditions and the course of activity; and peculiarities of the monthly averages of radioactivity during 1959. (M.C.G.)

27882 PETROGRAPHY AND ORIGIN OF ZENOTIME AND MONAZITE CONCENTRATIONS, CENTRAL CITY DISTRICT, COLORADO. E. J. Young and P. K. Sims (Geological Survey, Washington, D. C.). Geological Survey Bulletin 1032-F. 1961. 26p.

Xenotime and monazite are uncommonly abundant in Precambrian biotite gneiss and migmatite at three localities

near Central City, Gilpin County, Colo. The occurrences are in the lower part of a thick layer of migmatized biotite gneiss in a sequence of rocks that were metamorphosed to the almandine amphibolite facies. The zones of concentration are a maximum of about 5 feet thick and a few hundred feet long, and contain about 1 to 5% by volume combined xenotime and monazite. The rare-earth minerals occur dominantly as aggregates of sand-size crystals in thin layers and clots of biotite, which are much coarser than the mica in the typical biotite gneiss. Xenotime is more abundant than monazite in 2 of the 3 occurrences. Both minerals are subrounded to rounded and crystal faces are rare. The two minerals appear to have crystallized contemporaneously. Except for magnetite, other accessory minerals that are common to the country rock are not concentrated with the xenotime and monazite. The field and laboratory data are consistent with the hypothesis that the rare-earth minerals were concentrated at their present sites during migmatization of the biotite gneiss country rock, in a period of Precambrian plastic deformation. Presumably, granitic fluids derived during the deformation selectively mobilized rare-earth cations and phosphate from the biotite gneiss country rock. These ions crystallized with biotite and locally with magnetite to form zones of xenotime and monazite concentrations in migmatized parts of the gneiss. (auth)

27883 PRELIMINARY GEOLOGIC MAP AND SECTION OF THE MOUNT PEALE 4 NW QUADRANGLE. SAN JUAN COUNTY, UTAH. G. W. Weir, W. P. Puffett, and C. L. Dodson (Geological Survey, Washington, D. C.). Mineral Investigations Field Studies Map MF-151. 1961. Charge $0.50(USGS)

27884 PRELIMINARY GEOLOGIC MAP OF THE SOUTHWEST QUARTER OF THE BOULDER QUADRANGLE, MONTANA. Darrell M. Pickney and George E. Becraft (Geological Survey, Washington, D. C.). Mineral Investigations Field Studies Map MF-187. 1961. Charge $0.50(USGS)

27885 PRELIMINARY GEOLOGIC MAP OF THE PARIA PLATEAU SE QUADRANGLE. COCONINO COUNTY, ARIZONA. Richard G. Petersen (Geological Survey, Washington, D. C.). Mineral Investigations Field Studies Map MF-196. 1961. Charge $0.50(USGS)

HEALTH AND SAFETY

27886 (ARF-3187-5) ELECTROSTATIC CLASSIFICATION OF SUBMICRON AIRBORNE PARTICLES. Final Report, October 15, 1960 to August 15, 1961. G. Langer (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Aug. 15, 1961. Contract AT(11-1)-578. 46p.

The variables affecting electrostatic classification of submicron aerosols were studied. An improved charger was developed which operates without attention for many hours and has no corona glow. Techniques were developed for obtaining light-microscope samples with cover slips and electron-microscope deposits with screens attached directly to the collector plate. Overlap between large and small particles was overcome by a high, stable charging rate. A neutralizer to overcome interference from the initial charge on aerosols was tested. A generator was set up for producing monodispersed gold aerosols 0.015 μ in diameter from gold colloid. Calculations showed that classification at reduced pressure is feasible. The classifier was tested at high sampling rates and velocities. (D.L.C.)

27887 (DTC-1) RADIOACTIVE PRODUCTS IN THE SOIL AND IN THE ATMOSPHERE. (Brazil. Comissao Nacional de Energia Nuclear). 1958. 118p.

A partial survey of Brazilian radioactivity levels in several sample regions was conducted. These measurements were concerned only with natural gamma radiation levels. Selected areas were typically different with regard to the geological structure and genesis of their active deposits, the configuration and intensity of radiometric levels, and the extent and variety of possible biological observations and experiments. (J.R.D.)

27888 (ERDL-1673-RR) REMOVAL OF NUCLEAR BOMB DEBRIS, STRONTIUM 90–YTTRIUM 90, AND CESIUM 137–BARIUM 137 FROM WATER WITH CORPS OF ENGINEERS MOBILE WATER-TREATING EQUIPMENT. Maurice Pressman, Don C. Lindsten, and Richard P. Schmitt (Army Engineer Research and Development Labs., Fort Belvoir, Va.). May 23, 1961. 52p.

The evaluation of three water-treating units at the Nevada Test Site for radioactivity-removal efficiency is reported for the standard army mobile water purification unit (1500 gph), a prototype mobile ion exchange unit (1500 gph), and an electrodialysis demineralization unit (30 gph). It was concluded that: standard field water purification equipment employing continuous coagulation and diatomite filtration is capable of removing over 99% of insoluble or suspended radioactive contaminants from water; standard water purification equipment employing continuous coagulation and diatomite filtration followed by a water demineralization process is capable of removing over 99% of the insoluble and soluble radioactive contaminants from water; and diatomite filter membranes, ion exchange resins, permselective membranes, and equipment in contact with radioactive liquids and subject to corrosion contain some radioactivity after normal decontamination. (auth)

27889 (FZM-2277) GRAPHIC AND TABULAR AIDS FOR REACTOR HAZARDS EVALUATIONS. J. C. Couchman (Convair, Fort Worth, Tex.). June 9, 1961. 37p.

Presented to the Health Physics Society Meeting, Las Vegas, Nevada, June 12-16, 1961.

Graphic and tabular aids were devised that make possible a quick estimate of environmental hazards resulting from a nuclear reactor accident. These include curves of the reactor buildup of biologically hazardous fission products, tables of experimental release, an atmospheric dispersal model, an analytic expression and curves for determining exposure isopleth areas, tables of deposition velocities, and curves for estimating external dose from cloud passage. These, as well as the biological exposure criteria used for hazards studies, are discussed. (auth)

27890 (HW-68435) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD FOR 1960. I. C. Nelson, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1, 1961. Contract AT(45-1)-1350. 115p.

The results of the Hanford environmental monitoring program for 1960 are presented in detail. The measurement results are summarized and evaluations are made in terms of exposures and other effects. The principal Hanford source of exposure to persons in the neighborhood of the controlled area is identified with the neutron induced radionuclides present in reactor cooling water discharged to the Columbia River. The primary mechanisms of exposure from this source are the drinking of sanitary water derived from the river and the consumption of fish and waterfowl which inhabit the river. Hanford's contribution to environmental exposure through atmospheric paths is generally less than that due to fallout from nuclear detonations. Many variables, such as multiple sources, paths of intake, individual diets, periods of occupancy, and so forth, complicate expression of environmental exposure. Potential exposures are, however, calculated for hypothetical persons based on plausible assumptions on sources, diets, etc. For such individuals whose habits include ingestion of Pasco sanitary water, ingestion of local fish and waterfowl, and consumption of produce from local farms, the data suggest an intake of bone-seeking radionuclides of about 40% of that recommended by the NCRP as maximum for continuous intake by individuals in the neighborhood of controlled areas. For those persons who drink Pasco water but who do not routinely eat fish or waterfowl from the Columbia River, the exposure appears to be on the order of 5% of the recommended maximum (in this case to the GI tract). For individuals who make no use of the Columbia River or products derived therefrom, the intake of bone seekers is estimated as about 3% of the recommended maximum, the bulk of which was due to world wide fall-out. Comparison of measurement results for 1960 with those of 1959 indicate that no significant change occurred in the radiological conditions in the vicinity of Hanford. (auth)

27891 (HW-68857) HANFORD PLUTONIUM CRITICAL MASS LABORATORY, NUCLEAR SAFETY, OPERATIONAL LIMITATIONS, INSTRUCTIONS, AND EMERGENCY PROCEDURES. E. D. Clayton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1, 1961. Contract AT(45-1)-1350. 49p.

Outlines are given which describe: the philosophy governing nuclear safety in the Laboratory Operations; the procedures to be followed to secure approval for conducting experiments; the operational limits for conducting experiments; the general operating instructions for use during experiment operation; and the emergency procedures to be followed in the event of a nuclear excursion. Discussions are included of the safety and interlock systems, as well as the procedure for pre-startup check out of instrumentation, interlock, and control systems. Responsibilities are defined for nuclear safety, and for action during an emergency involving a nuclear excursion. (B.O.G.)

27892 (HW-69764) DETERMINATION OF ELUTION RATE OF A ZEOLITE-ADSORBED RADIO ISOTOPE IN A RIVER. B. W. Mercer and J. F. Honstead (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 29, 1961. Contract AT-(45-1)-1350. 10p.

An investigation was made of the elution rate of a zeolite-adsorbed radioisotope for evaluation of the shipping hazards. Measurements were obtained by means of shallow beds eluted at a high flow rate. Columbia River water eluted strontium at a nearly constant rate of 3.5% per hr. The elution rate with a somewhat higher salt content in the water, simulating the Missouri River water, was initially about 30% per hr but dropped to about 6% per hr after 2 hr. (M.C.G.)

27893 (HW-70706) SOME RADIOACTIVE MATERIALS MEASURED IN VARIOUS WATERS IN THE UNITED STATES. A LITERATURE SEARCH. J. K. Soldat (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 15, 1961. Contract AT(45-1)-1350. 19p.

A literature search was made to obtain information concerning radioactive materials present in the major rivers of the U. S. Data are tabulated by major river systems and sections of the country. Supplemental data are included on river sediments and other types of waters. (C.H.)

27894 (JAERI-6007) GUIDE TO SAFE HANDLING OF RADIATION. Reference Document No. 7. (Japan Atomic Energy Research Inst., Tokyo). Mar. 1961. 82p. (In Japanese)

The safe handling of radioactive materials is discussed. Topics covered include emergency measures, permissible radiation dosage to employees, permissible density of radioactive materials, standard control over surface contamination, special area and control facilities, establishment and indication of special area, access to control and purified areas, handling of individual exposure measuring instruments, precautions in handling radioactive materials and operating reactors and accelerators, treatment of radioactive wastes, decontamination, storing and transport of radioactive materials, and a summary of responsibility regarding radiation safety. (M.C.G.)

27895 (NAVDOCKS-TP-TE-6) RADIOACTIVITY IN WATER SUPPLY AND WASTE WATER SYSTEMS: PEACETIME DETECTION AND CONTROL. (Bureau of Yards and Docks). June 1960. 92p. ([PB]-171091)

Information on the detection, handling, and disposal of peacetime radioactive contamination in water supplies and wastes is presented. Included are the causes and characteristics of radioactivity; the biological effects of radiation; the allowable concentrations of radionuclides; methods of determining nuclide concentrations and removing radionuclides; the detection, analysis, and monitoring of radioactivity in water supplies and wastes; personnel protection through safety precautions in plant operations; and the authority and responsibility of the bureaus of the Navy Department in the field of activities concerned. (M.C.G.)

27896 (CEA-tr-R-1312) PROBLEMES SANITAIRES RELATIFS AU TRANSPORT DES ISOTOPES RADIOACTIFS. (Sanitary Problems Relative to the Transport of Radioactive Isotopes). R. S. Kalinova. Translated into French from Gigiena i Sanit., 23: 41-6(Oct. 1958). 18p.

The results of investigations of various types of transport containers with respect to sanitary-hygienic requirements and data from dosimetric examinations of a group of workmen employed in the transportation of radioisotopes are presented. Various defects were noted in some types of containers presently in use. The data show that it is necessary to improve the system for radioisotope transportation and to construct containers in accordance with sanitary-hygienic requirements. (auth)

27897 A SIMPLE METHOD OF REDUCING THE FLUOROSCOPIC DOSE RATE. Edwin L. Lame (Presbyterian Hospital, Philadelphia). Am. J. Roentgenol., Radium Therapy Nuclear Med., 86: 594-6(Sept. 1961).

A simple and very inexpensive plan is described for reducing x-ray dose rate in fluoroscopy. It allows the examination of delicate tissues that otherwise would be rejected for fluoroscopy. It is suggested that this method is worthy of wider trial in view of the continued prevalence of more robust fluoroscopic examination. (auth)

27898 THE IMPACT OF NUCLEAR PROPULSION OF SHIPS ON ADMIRALTY AND SHIPPING LAW. E. Robert Seaver. At. Energy Law J., 2: 303-21(Fall 1960).

A review is given of the principles and legal uniformity of maritime nations with respect to liabilities associated with nuclear propelled ships. The review was obtained from the Convention of Admiralty Bar and representatives of several nations to a discussion of the development of an international law designed to afford financial protection to the public and promote the use of nuclear power for shipping. (N.W.R.)

27899 BASIC LEGISLATION ON RADIATION PROTECTION. Edwin E. Ferguson (Atomic Energy Commission, Washington, D. C.). At. Energy Law J., 2: 322-33(Fall 1960).

Basic legislation on radiation protection is discussed as it was adopted by the Atomic Energy Act of 1946 and the revision of 1954. Special attention is placed on permissible radiation dosage in the United States and abroad as set up by the ICRP and NCRP. Briefly discussed are regulations for the control of production and utilization facilities. (N.W.R.)

27900 THE MAXIMUM PERMISSIBLE CONCENTRATIONS OF THE RADIOACTIVE ISOTOPES OF INERT GASES ORIGINATING FROM FISSION PRODUCTS. Yu. V. Sivintsev. Atomnaya Energ., 10: 631-2(June 1961). (In Russian)

In evaluating the radiation-safety features of reactors, not only Kr-85 and Xe-133 with half-lives of 9.4 years and 5.3 days but all the ejected radioactive gases must be taken into consideration. This is especially important for homogeneous reactors and for homogeneous systems with unclad or imperfectly clad fuel elements. As a result of their inert nature, these gases are not retained by the body and do not present a problem as internal beta- or gamma-emitters. The MPC values of these elements were determined previously, but it was found necessary to increase the numerical factor by 2 in order to take into consideration the actual 2π geometry of a human body irradiated in a space filled with the radioactive gas. The calculated MPC values for seven Kr and six Xe isotopes are tabulated. (TTT)

27901 ARTIFICIAL RADIOACTIVITY IN THE AIR. J.-Cl. Philippot. Bull. inform. sci. et tech. (Paris), No. 52, 45-7(June 1961). (In French)

Values are tabulated for β activity in the air at 0, 9, and 12 km for 1959 and 1960 in France. The data are analyzed to yield a rate of fall-out of about 0.2 km per day. (T.R.H.)

27902 RADIATION PROTECTION AND HEALTH CONTROL OF X-RAY WORKERS IN THE NATIONAL HOSPITAL AND SANATORIUM IN THE DISTRICT OF HOKKAIDO. M. Nakama. J. Japan Assoc. X-ray Tech., 6: No. 7, 9-29 (1959).

The measurement of exposure doses of x-ray workers showed that these doses were under 30 mr for a period of 15 days, and 15 out of 17 institutions, by means of the film badge method. Measurement by the pocket ionization chamber method showed that the exposure dose was about 10 to 40 mr. By the x-ray film method, the exposure dose was under 10 mr when compared with a standard density film. The exposure dose after 20 chest fluoroscopes and 5 abdominal fluoroscopes was in the range of 1800 mr at the maximum, and under 30 mr measured on the hand dorsum. The exposure dose in x-ray technicians, assistants, and doctors increased in this order. Among 30 x-ray workers 11 showed a low RBC count and 7 a low leukocyte count. The more the years of working, the less the erythrocyte counts. (Abstr. Japan Med., 1: No. 10, 1961).

27903 ENVIRONMENTAL MONITORING AFTER ACCIDENTAL DEPOSITION OF RADIOACTIVITY. A. C. Chamberlain, R. J. Garner, and D. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 14: 155-67(July 1961).

The entry of accidentally dispersed activity into milk is considered. From experimental data on the transfer of radioiodine, radiostrontium, and radiocesium from grass to milk by the cow, the emergency permissible deposition of these substances on grass is calculated and compared with the relative abundance of the nuclides on various assumptions. It is concluded that I^{131} will nearly always be the limiting factor, though only marginally so if fission products are deposited in the proportions found in the reactor. The assessment of deposition of I^{131} by measurement of gamma dose rate is considered. The dose rates at 3 and 500 feet above ground and the corresponding responses of gamma scintillator instruments are calculated. If I^{131} is the only activity deposited, the increase in dose rate above background corresponding to the emergency permissible deposition (0.4 $\mu c/m^2$) is 3.3 $\mu r/hr$ at 3 feet and about 0.3 $\mu r/hr$ at 500 feet. The problems of measuring these dose rates by car-borne or aerial survey are discussed and illustrated by results obtained after the Windscale accident of October 1957. (auth)

27904 INFLUENCE OF TEMPERATURE AND RELATIVE HUMIDITY ON THE PHOTOGRAPHIC RESPONSE TO Co^{60} GAMMA RADIATION. Margarete Ehrlich. J. Research Natl. Bur. Standards, 65C: 203-5(July-Sept. 1961).

At relative humidities close to a hundred percent, bare film packets are unsatisfactory for personnel dosimetry, regardless of temperature. Sealed polyethylene bags afford considerable protection from excessive humidity. (auth)

27905 NUCLEAR RADIATION STANDARDS. Ruzena Simanova (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 7: 227-33 (1961). (In Czech.)

A survey of characteristic properties of the most important radioisotopes used as radioactivity standards, except tritium, C^{14}, and radium is given. Decay schemes and standard preparation methods are reported. (auth)

27906 DIAGRAMS FOR DOSE DETERMINATION OF LINEAR GAMMA SOURCES. Ruprecht Andres and K. E. Scheer (Universität, Heidelberg, Ger.). Nuclear-Med., 1: 407-13(1961). (In German)

By means of diagrams, dose and dose rates for typical implantations of linear sources of radioactive nuclides can easily be found. Examples are given. (auth)

27907 RADIATION DOSIMETER UTILIZING THE THERMOLUMINESCENCE OF LITHIUM FLUORIDE. J. R. Cameron, F. Daniels, Noye Johnson, G. Kenney (Univ. of Wisconsin, Madison). Science, 134: 333-4(Aug. 4, 1961).

A dosimeter, with little wave-length dependence and large useful energy range for electromagnetic radiation, which is simple to use and read, was developed. It appears to have applications in personnel monitoring as well as radiation research. (auth)

27908 RADIATION PROTECTION CRITERIA AND STANDARDS: THEIR BASIS AND USE. INDEX TO HEARINGS AND SELECTED MATERIALS OF MAY 1960, SPECIAL SUBCOMMITTEE ON RADIATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES. (United States. Congress. Joint Committee on Atomic Energy). June 1961. 97p. Charge $0.30(GPO).

27909 PEACETIME RADIATION HAZARDS IN THE FIRE SERVICE. ORIENTATION UNIT—INSTRUCTOR'S GUIDE. Circular No. 641. (Department of Health, Education, and Welfare. Office of Education, Washington, D. C. and Office of Industrial Relations, AEC). 1961. 52p. (OE-84014). $0.35(GPO).

An instructor's guide and a series of charts are presented for instruction concerning peacetime radiation hazards in the fire service. Topics covered include locating local nuclear energy hazards, the general problem of radiation, characteristics and problems of both external and internal radiation, review of the common forms of radiation and the hazard they present, nuclear reactor problems pertinent to the fire service, the fire department's responsibility in the nuclear age, and special firefighting techniques used at nuclear incidents. (M.C.G.)

27910 PEACETIME RADIATION HAZARDS IN THE FIRE SERVICE. ORIENTATION UNIT—STUDENT MANUAL. Circular No. 642. (Department of Health, Education, and Welfare. Office of Education, Washington, D. C. and Office of Industrial Relations, AEC). 1961. 39p. (OE-84015). $0.30(GPO).

A manual designed to be used by fireman trainees participating in the orientation unit on peacetime radiation hazards is presented. Topics covered include radioactive iodine to trace thyroid gland disorders, measuring metal wear, use of radioactive materials for quality control in industry, treatment of disease by radiation, difference between radioactive and fissionable materials, radiation warning symbol, samples of radiation warning signs, external radiation, internal radiation, effects of long range penetrating external radiation, effects of short range less penetrating external radiation, external radiation dosages, time as protection against external radiation, shielding as protection against external radiation, three common types of radiation, typical Geiger-Mueller counter dial, typical ionization chamber dial, masks as protection from internal radiation, mask removal procedure, contamination control during firefighting operations, radioactive contamination of smoke and water, radioactive half life, types of radiation and their hazards, the nuclear chain reaction, concept of criticality, suggested radiation prefire plan, and typical radiation prefire plan sketch of building. (M.C.G.)

27911 RADIOLOGICAL HEALTH DATA MONTHLY REPORT, AUGUST 1961. VOLUME II, NUMBER 8. (Public Health Service, Washington, D. C.). 47p. $0.50 (GPO).

Data are tabulated on the radioactivity in samples of air,

milk, foods other than milk, surface waters, and cistern waters collected from various parts of the United States. Results are summarized on average surface-air measurements made at selected stations from 1957 through 1960 and atmospheric fission product gross beta measurements made at ground level throughout Italy during 1960. Results are included on environmental levels of radioactivity in the vicinity of four Atomic Energy Commission installations during the fourth quarter of 1960. Data are included from measurements of Ra^{226} in bovine bones and teeth. Current plans to control radiation exposure in the United States are discussed. (C.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

27912 (BMI-X-174) RADIOISOTOPE AND RADIATION APPLICATIONS. Quarterly Progress Report. Duane N. Sunderman, ed. (Battelle Memorial Inst., Columbus, Ohio). July 18, 1961. Contract W-7405-eng-92. 13p.

The study of the formation mechanism of free radicals in polymeric materials was continued. Emphasis was placed on an examination of the effect of structural factors on the efficiency of free-radical site formation in acrylate polymers. Site measurements as a function of dose were made for polymethacrylamide and repeated for polymethacrylic acid. The volatile products from the irradiation of polyacrylic acid, polymethacrylic acid, poly-ter-butylmethacrylate, and polycyclohexyl methacrylate were measured quantitatively by mass spectrometry and vapor-phase chromatography. Grafting studies were initiated using polymethylmethacrylate as base polymer and vinylpyrrolidone as graft monomer. (auth)

27913 (SRO-46) CESIUM-137 RESEARCH IRRADIATOR. Final Report covering Period April 1, 1959 to March 31, 1961. R. W. Carter, R. C. Palmer, and W. V. Willis (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Apr. 20, 1961. Contract AT(38-1)-202. 32p.

A 12 kC cesium-137 research irradiator is designed and installed. The physical characteristics of the irradiator are evaluated. The basic design is a slight modification of the Notre Dame cobalt-60 irradiator. The center sample hole has a homogeneous radiation field through a vertical movement of 3 inches, which gives a homogeneous dose to approximately 150 grams of material with a bulk density of one. The dose rate in the center sample hole is 1.4 Mrad/hr. The twelve outer holes, although irradiated from one side only, present a uniform radiation field to a sample over a length of 3 inches. The dose rate in the outer holes is 1 Mrad/hr. (auth)

27914 (TID-12711) POSSIBLE REQUIREMENTS FOR RADIOISOTOPES AS POWER SOURCES. William H. McVey (Office of Operations Analysis and Forecasting, AEC). Apr. 1961. 15p.

The current status of possible relatively large scale uses of separated fission products and certain alpha-emitting isotopes is reported. Types of applications which may lead to large-scale uses are reviewed and aspects which must be considered in evaluating these uses, specific isotopes of interest such as Pu^{238} and Cm^{242}, and quantities involved are discussed. (J.R.D.)

27915 (TID-12768) UTILIZATION OF RADIOISOTOPE EXCITED X-RAY SOURCES FOR THE ANALYSIS OF HIGH Z ATOMS IN LOW Z MEDIA. Quarterly Progress Report, January 15,—May 31, 1961. (Tracerlab, Inc., Waltham, Mass.). Contract AT(30-1)-2538. 23p.

Fabrication and assembly of the gage and its electronic components were accomplished. Two x-ray sources, differing in intensity by a factor of two, were prepared and evaluated. The electronic components were modified as necessary, and evaluated in the unit. A rework of one component was found necessary, delaying the final checkout of the unit and establishment of its performance specifications. Preliminary testing of the unit by a modified technique indicated that the gage head is meeting the required design parameters. A response curve is presented which, although not of high accuracy, adequately demonstrates that successful performance of the final unit should be achieved upon completion of the necessary rework. (auth)

27916 (TID-13565) RADIOISOTOPES RESEARCH, DEVELOPMENT, AND RELATED ACTIVITIES. Tenth Quarterly Progress Report, March 15, 1961 to June 15, 1961. (Chicago. Univ. Labs. for Applied Sciences). July 1961. Contract AT(11-1)-712. 27p. (LAS-SR-P161-29)

Progress is reported briefly for research projects on wear and lubrication studies of piston rings, development of a gammacon tube, density and moisture content determination in stored coal, and application of Rutherford scattering to the chemical analysis of solids. A paper on the design and calibration of gamma ray density meters is included. (D.L.C.)

27917 (AEC-tr-4475) TRANSACTIONS OF THE ALL-UNION SCIENTIFIC TECHNICAL CONFERENCE ON THE USE OF RADIOACTIVE AND STABLE ISOTOPES AND RADIATIONS IN THE NATIONAL ECONOMY AND IN SCIENCE, APRIL 4-12, 1957. PROSPECTING AND DEVELOPMENT OF USEFUL MINERALS. Translation of Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh. 1958. 286p.

Thirty-four papers are included for each of which a separate abstract was prepared. (J.R.D.)

27918 (AEC-tr-4475(p.1-11)) ACHIEVEMENTS OF NATIONAL SCIENCE AND INDUSTRY IN USING RADIOACTIVE METHODS FOR PROSPECTING AND DEVELOPING USEFUL MINERALS. V. N. Dakhnov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 3-16(1958).

A review of radioactive methods for prospecting and development of minerals is presented. Techniques discussed include neutron-logging, gamma radiation well-logging applications, and other radiometric variations. (J.R.D.)

27919 (AEC-tr-4475(p.12-25)) OUTLOOK FOR THE UTILIZATION OF RADIOACTIVE RADIATIONS IN GEOLOGY DURING THE SEARCH AND PROSPECTING OF USEFUL MINERALS. G. N. Flerov, F. A. Alekseev, B. G. Erozolimskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, Iskopaemykh., 17-28(1958).

Future development in radio-prospecting is assessed. It was concluded that the methods of nuclear physics in the field of geology can have wide and very effective application. It is noted that the applications so far have been inadequate, however there are many reasons to believe that the new methods and modern equipment will play a large role in USSR mineral prospecting. (J.R.D.)

27920 (AEC-tr-4475(p.26-37)) RADIOACTIVE LOGGING AT COAL DEPOSITS. Yu. B. Bulashevich, E. P.

Didenko, I. N. Sen'ko-Bulatnyi, and A. P. Fisenko. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 29-38(1958).

Data obtained in gamma-gamma logging in Eastern Ural coal deposits and Kizelovsk deposits, and results of differential gamma-gamma logging at the Chelyabinsk deposit are examined. A practical evaluation of neutron-gamma logging for coal deposits is also included. (J.R.D.)

27921 (AEC-tr-4475(p.38-51)) USE OF RADIOACTIVE METHODS FOR THE INVESTIGATION OF PETROLEUM AND GAS BOREHOLES. D. M. Srebrodol'skii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 39-50(1958).

A review of the development and use of radioactive methods is presented. The effectiveness of borehole radiometry in the Bashkir and Tartar deposits is given especial attention, however operations at numerous other locations are described, and the various uses for radioisotopes in petroleum geology are outlined. It is concluded that by comparing radiometric diagrams with other geophysical methods it is possible in most cases to locate gas, petroleum, and water-bearing layers. (J.R.D.)

27922 (AEC-tr-4475(p.52-8)) RADIOMETRIC METHOD OF PROSPECTING OIL; THE STATE AND DEVELOPMENT OF THE METHOD, AND EXPERIENCE IN ITS APPLICATION. F. A. Alekseev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 51-6(1958).

A review of the state-of-the-art in radiometric oil prospecting in the USSR is presented. It is noted that with the existing level of geological science, there are no undisputed criteria for evaluating petroleum-bearing capacity, and there are no direct methods for prospecting petroleum and gas deposits. Included are discussions on radiometric methods, and on anomalies and principles of interpretation. (J.R.D.)

27923 (AEC-tr-4475(p.59-66)) USE OF RADIOACTIVE ISOTOPES FOR THE INVESTIGATION OF COAL-TEST BOREHOLES. S. M. Zhitnikova and I. A. Savinets. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 57-61(1958).

Investigation of coal-test boreholes by gamma-gamma logging is reported. The method is considered better than those using electricity. It was shown that it is possible to obtain qualitative data by using gamma sources with an intensity of no more than one to five mc. (J.R.D.)

27924 (AEC-tr-4475(p.67-74)) EXPERIENCE OF THE USE OF NUCLEAR METHODS IN THE INVESTIGATION OF CROSS SECTIONS OF BOREHOLES BEING DRILLED FOR WATER. V. A. Rapolova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 62-8(1958).

Investigations of water boreholes by gamma and neutron gamma methods are reported. The investigations were conducted under various hydrogeological conditions. The possibilities of radioactive methods utilization in evaluating the water-yielding properties of the collectors were evaluated. Cross sections of sand-clay, carbonate, and granites were examined. (J.R.D.)

27925 (AEC-tr-4475(p.75-82)) USE OF RADIOMETRIC METHODS FOR GEOLOGICAL MAPPING. A. F. Kondratenko. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 69-75(1958).

The effectiveness of radiometric geological mapping is discussed and illustrated by examples from the work of a Russian geophysical expedition. The radiometric work done on this expedition is compared with results obtained by the use of other geophysical methods. It is shown by the examples that radiometric methods are more effective than others. (J.R.D.)

27926 (AEC-tr-4475(p.91-3)) PROSPECTING OF POTASSIUM SALTS BY RADIOACTIVE METHODS. K. S. Pshevlotskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rosvedka i Razrabotka Poleznykh Iskopaemykh., 82-4(1958).

Radiometric assistance to conventional methods for establishment of potassium salt deposit stratigraphic position is described. The method is based on the natural radioactivity of K^{40}. Neutron methods for determination of potassium salt composition is also described. (J.R.D.)

27927 (AEC-tr-4475(p.94-105)) BASIC PROBLEMS OF THE PROCEDURE OF RADIOMETRY OF BOREHOLES AND THE STATE OF THEIR DEVELOPMENT. V. M. Zaporozhets and V. V. Sulin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 85-93(1958).

A review of procedures and uses of radiometry in assessing boreholes is presented and a discussion of several problems related to the procedures are examined. (J.R.D.)

27928 (AEC-tr-4475(p.106-10)) PROBLEM OF SEPARATE STUDY OF THE PROCESSES OF RETARDATION AND ABSORPTION OF NEUTRONS IN ROCKS. A. I. Kholin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 94-7(1958).

Despite long usage of neutrons in borehole investigations. these methods are still restricted to qualitative studies in the cases of petroleum and gas boreholes. Interpretations of diagrams depending on neutron methods are hampered by the fact that readings simultaneously reflect the processes of retardation and absorption of neutrons. Efforts in development are discussed and it is pointed out that neutron methods have a great potential use in borehole examinations. (J.R.D.)

27929 (AEC-tr-4475(p.111-25)) QUANTITATIVE INTERPRETATION OF DATA OF RADIOMETRY OF BOREHOLES. Yu. A. Gulin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke. Moscow. 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 98-110 (1958).

The natural radioactivity of rocks. their volumetric density, and the H and Cl content may be determined in borehole samples by radiometry. A review of quantitative radiometric methods and their use in these areas is presented. (J.R.D.)

27930 (AEC-tr-4475(p.126-33)) UTILIZATION OF NEUTRON METHODS FOR THE STUDY OF THE GEOLOGICAL CROSS SECTION OF BOREHOLES, COLLECTOR CHARACTERISTICS, AND SEPARATION OF GAS- AND PETROLEUM-BEARING LAYERS. F. Ts. Kron and V. P. Odinokov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 111-17(1958).

Results of laboratory work on neutron–neutron well logging is presented. The data appears to substantiate the belief that the method has great potential usefulness for investigating carbonate cross section, separation of porous zones, quantitative determination of porosity, and determination of borehole water-petroleum contact. (J.R.D.)

27931 (AEC-tr-4475(p.134-40)) EVALUATION OF THE POROSITY AND PETROLEUM SATURATION OF SAND-CLAY COLLECTORS BY THE NEUTRON GAMMA METHOD FROM THE CHLORINE CONTENT. V. V. Larionov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 118-22(1958).

The evaluation is summarized by basic conclusions. It was concluded that in sand-aleuralite the basic effects exerted on the neutron gamma method is by chlorine content variations. An almost linear relation exists between rock porosity and neutron-gamma readings and between these readings and mineral-water saturated sand stones. The neutron-gamma method needs increased sensitivity. (J.R.D.)

27932 (AEC-tr-4475(p.141-50)) SOME PROBLEMS OF THE PROCEDURE OF RADIOMETRY OF BOREHOLES. V. P. Ivankin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 123-31(1958).

Radiometric procedures used in the lower Volga area adapted to well-logging in clays and other mud are discussed. Data are included. It is pointed out that radioisotopes are recommended for detection of collectors in boreholes. Discussions of borehole examination by gamma and neutron-gamma methods are also included. (J.R.D.)

27933 (AEC-tr-4475(p.157-64)) THE INFLUENCE OF THE ZONE OF PENETRATION OF FRESH FILTRATE OF THE DRILL MUD IN THE LAYER ON THE RESULTS OF THE NEUTRON GAMMA METHOD. Yu. V. Galuzo. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 137-43(1958).

It is noted that evaluation of petroleum saturation in collectors and determination of water-petroleum contacts are affected by the existence of a zone of penetration of fresh filtrate which surrounds drills in prospecting operations. The existence of this zone can distort the results of investigations especially by the neutron gamma method. Suggestions for steps to aid in measurement interpretation under these conditions are presented. (J.R.D.)

27934 (AEC-tr-4475(p.165-73)) EFFECTIVE RADIUS OF INVESTIGATION OF RADIOMETRY OF BOREHOLES. A. V. Zolotov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 144-51(1958).

A model artifical layer was studied to determine characteristics of various depth (radius) parameters for borehole radiometry diagram interpretation. The effective radius of investigation by use of isotopes and by natural radioactivity of rocks is discussed along with the effective radius as determined by the neutron gamma method, induced activity method, and the neutron-neutron method. (J.R.D.)

27935 (AEC-tr-4475(p.174-80)) STUDY ON MODELS OF THE DISTRIBUTION OF NEUTRONS IN PETROLEUM-BEARING AND WATER-BEARING COLLECTORS INTERSECTED BY A BOREHOLE. O. A. Barsukov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 152-7(1958).

Results obtained in an investigation of neutron spatial-energy distribution in borehole layer systems are examined. Models of petroleum-bearing and water-bearing collectors were used in the experiments. Results indicate that the effectiveness of petroleum–water layer separation depends on the measurement conditions, and on the spectrum of the registered neutrons. (J.R.D.)

27936 (AEC-tr-4475(p.181-91)) THEORY OF NEUTRON METHODS OF INVESTIGATION OF BOREHOLES. S. A. Kantor and A. Ya. Temkin. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 158-66(1958).

The distribution of neutrons in boreholes and in rock may be calculated by solution of the kinetic equation of neutron retardation. A model of this equation is given and factors in evaluation of layer models for neutron investigations of boreholes are discussed. Calculations related to the distribution of epithermal neutron density along the borehole axis are presented along with calculation of neutron distribution in hydrogen-containing media. (J.R.D.)

27937 (AEC-tr-4475(p.192-200)) THE PROBLEM OF THE USE OF RADIOACTIVE ISOTOPES IN THE PETROLEUM INDUSTRY. A. A. Korzhev. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 167-74(1958).

Aspects of radioisotope use in the petroleum industry are discussed. In petroleum establishments, use is made of radioisotopes which radiate gamma of sufficient energy for tracking operations with tagged atoms and to assure measurement through the steel cases of depth instruments. Data on the properties of isotopes now in use are tabulated. Because of the possibilities of borehole contamination it is recommended that short lived isotopes such as I^{131}, Rb^{131}, and Fe^{59} be used. (J.R.D.)

27938 (AEC-tr-4475(p.201-9)) RADIOMETRIC MEASUREMENTS IN BOREHOLES AT HIGH TEMPERATURES. G. N. Strotskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 175-82(1958).

Design and operation of a heat-resistant radiation detection instrument are described for use in borehole temperatures up to 150 or 170°C. Uses and modifications related to borehole operations are described for the counter and working examples are given. (J.R.D.)

27939 (AEC-tr-4475(p.210-19)) RESULTS OF THE APPLICATION OF RADIOACTIVE ISOTOPES FOR THE

STUDY OF THE BOREHOLES OF THE BASHNEFT' ASSOCIATION. A. Sh. Galyavich. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 183-90(1958).

Radioisotopes such as Co^{60}, Zn^{65}, Zr^{95}, and Fe^{59} were used to investigate boreholes. The work was conducted to determine the location of column breaches, to control layer hydraulic rupture, and to check the quality of cementing. Results show that isotopes have a wide field of application in borehole investigations. Recommendations include development of methods for controlling layer hydraulic ruptures, improvement of existing depth instruments, and investigation of adsorptive properties of rocks. (J.R.D.)

27940 (AEC-tr-4475(p.220-4)) STUDY OF THE DYNAMICS OF UNDERGROUND WATERS BY MEANS OF RADIOACTIVE ISOTOPES. Ya. B. Finkel'shtein, V. A. Filonov, V. N. Soifer, and M. P. Obukhova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 191-4(1958).

The use of pumped water to maintain layer pressure and to aid in more efficient extraction of petroleum from deposits is discussed. It is noted that an indicator to mark underground water levels is needed. The use of various isotopes such as tritium and deuterium is being investigated. The deuterium content of natural waters in the area of worked petroleum deposits is being given special attention; such work may lead to quantitative estimation of underground deuterium distribution and to use of the data in layer age determinations. (J.R.D.)

27941 (AEC-tr-4475(p.225-34)) RADIOMETRIC APPARATUS FOR THE INVESTIGATION OF PETROLEUM AND GAS DRILL HOLES. V. M. Zaporozhets and Ya. Ya. Gorskii (Gorskiy). Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 195-203 (1958).

Discussions and descriptions related to radiometric apparatus are presented including those on heat-resistant depth instruments, portable depth instruments, drill-hole cement eccentricity meters, luminescent counters and apparatus, and instrumentation for determination of water-petroleum contact in cased drill holes. (J.R.D.)

27942 (AEC-tr-4475(p.235-40)) POSSIBILITIES OF THE APPLICATION OF SCINTILLATION COUNTERS FOR THE RADIOMETRY OF BOREHOLES UNDER CONDITIONS OF HIGH TEMPERATURES. V. N. Mikhailovskii and Yu. I. Sitnitskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 204-8(1958).

A discussion of scintillation counters for use in high-temperature borehole radiometry is presented. It is noted that utilization of scintillation counters is limited and that avenues of development include a more temperature-resistant photomultiplier and a thermostating arrangement for the whole instrument. A discussion of solutions for these problems is included. (J.R.D.)

27943 (AEC-tr-4475(p.245-52)) THE PROBLEM OF THE INVESTIGATION OF BOREHOLES BY THE METHOD OF SCATTERED γ-RADIATION. E. M. Fillipov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 213-19(1958).

Investigation of boreholes by gamma-gamma logging is discussed. Experiments conducted using models shows that in investigation of boreholes with sondes smaller than or about equal to the borehole diameter, increased rock density leads to increased scattered gamma intensity. In studies of boreholes with sondes which exceed the borehole diameter by two or more times the scattered gamma intensity decreases with increasing rock density. (J.R.D.)

27944 (AEC-tr-4475(p.253-6)) CERTAIN PROBLEMS OF THE APPLICATION OF THE METHOD OF INDUCED ACTIVITY IN THE DETERMINATION OF THE POSITION OF WATER-PETROLEUM CONTACT. E. V. Blankov. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 220-2(1958).

The use of induced radioactivity for investigation of petroleum boreholes is described. It is noted that a 10-hr irradiation time is required to produce induced activity in Na while 10 min is required for Al, Cl, and Mn. Possibilities for future uses for this approach are discussed. (J.R.D.)

27945 (AEC-tr-4475(p.257-62)) UTILIZATION OF RADIOACTIVE ISOTOPES FOR THE STUDY OF EXPLOSIONS IN MINING. G. I. Pokrovskii and A. A. Chernigovskii. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 223-7(1958).

A discussion is presented of the use of radioisotopes for tagging rock components before underground explosions so that they can be identified by post-explosion monitoring. Other applications such as those related to earth dispersion problems are also discussed. It is noted that with further development, the use of radioisotope tagging can become a valuable tool for investigating the complex processes of explosions. (J.R.D.)

27946 (AEC-tr-4475(p.263-71)) USE OF RADIOACTIVE RADIATIONS FOR THE ENRICHMENT OF COALS AND CONTROL OF THEIR QUALITY. V. D. Goroshko. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 228-35(1958).

Activities are reported in investigations of radioactive methods for the beneficiation and enrichment of coal. To control the mineral content of coal, the difference in gamma and x ray slowing down in coal and rock are compared. A model radiometric separator is described and continuous automatic control of beneficiation is discussed. (J.R.D.)

27947 (AEC-tr-4475(p.272-6)) RADIOMETRIC METHOD IN INVESTIGATIONS OF THE MECHANISM OF BENEFICIATION OF COALS. V. D. Goroshko. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 236-9(1958).

The use of radioactive emanations to study the laws of compressed fall of bodies in fluids is reported in an investigation of coal beneficiation. The particles are labeled and the speed of descent is measured by a Geiger-Mueller counter. The installation is described. (J.R.D.)

27948 (AEC-tr-4475(p.277-86)) INDUSTRIAL EXPERIENCE OF THE CONTROL OF SUCCESSIVE PUMPING OF PETROLEUM PRODUCTS WITH THE USE OF A RADIOACTIVE INDICATOR. B. Z. Votlokhin, A. Z. Dorogochinskii, and N. P. Mel'nikova. Translated from Trudy Vsesoyuz. Nauch.-Tekh. Konf. Primenen. Radioaktiv. i Stabil'. Izotopov i Izluchenii v Narod. Khoz. i Nauke, Moscow, 1957. Rozvedka i Razrabotka Poleznykh Iskopaemykh., 240-8(1958).

The use of radioisotopic indicators in petroleum pipes and pumping systems for control of successive pumping is described. Low activity isotopes are used to track the movements. (J.R.D.)

27949 RADIOISOTOPES FOR INDUSTRIAL CONTROL MEASUREMENTS. Wolfgang Schäfer. A E G Mitt., 50: 318-20(Aug.-Sept. 1960). (In German)

In industrial control technology, radioisotopes are used for measurement of fullness, thickness, density, and other parameters. The fullness measurements are especially amenable in cases where there are strong-walled containers for corrosive and sticky fluids, for example tar, and for suspensions as well as for solids such as coal, lime, or stone. In addition to fullness control at a certain point, there are processes for continuous fullness measurement. By radiation absorption the thickness and density of the absorbing medium can be determined with high precision. (tr-auth)

27950 DENSITY MEASUREMENT WITH ISOTOPES. Bernhard Mengelkamp. A E G Mitt., 50: 321-6(Aug.-Sept. 1960). (In German)

Density measurement with isotopes depends on the absorption of radiation so that the measuring equipment can be mounted externally. As long as the process tube is not built-in or by-passed, radioactive density measurement is as good as the usual methods. (tr-auth)

27951 RADIATIONS FROM FISSION-PRODUCT PREPARATIONS. A. G. Bykov, P. V. Zimakov, and V. V. Kulichenko. Atomnaya Energ., 10: 362-7(Apr. 1961). (In Russian)

The feasibility of using mixed fission products as radiation sources is analyzed. Analytical and experimental data are given on total lifetimes and intensities of the β and γ emission of various isotopic fractions and their mixtures. β-active, two-year-old fractions and two- to six-month-old γ-active fractions produce the best results. Preparations of Sr^{90} and Cs^{137} are the most convenient for industrial use. (tr-auth)

27952 ON THE CHOICE OF THE RADIOISOTOPE IN TESTING MATERIALS BY MEANS OF GAMMA-RAY BACK-SCATTERING. A. S. Rudnitskii. Atomnaya Energ., 10: 400-2(Apr. 1961). (In Russian)

Testing material thickness or density as a function of radiation backscattering ($I(x) = J(x)/J(O)$, where $J(O)$ is initial intensity in the absence of material and $J(x)$ is the scattering intensity at material thickness or density x) is described. Characteristics of isotopes suitable for such use are tabulated; Co^{60} and Cs^{137} are the most economical. (R.V.J.)

27953 A POSSIBILITY OF UTILIZING RADIOACTIVE ISOTOPES FOR THE AUTOMATION OF THE CONCENTRATION OF OIL SHALE. I. Braun (Inst. of Cybernetics, Academy of Sciences, Estonian SSR). Izvest. Akad. Nauk Eston. S.S.R., Ser. Fiz.-Mat. i Tekh. Nauk, 9: 338-42(1960). (In Estonian)

Possibilities of utilizing isotopes for the concentration of oil shale are analyzed. Computations are given of some characteristics of oil shale and limestone (the chemical composition according to elements, the linear and mass-absorption coefficients, etc.) as well as some approximate computations of the size of the pieces of oil shale in which concentration can be effected with the aid of isotopes. (auth)

ISOTOPE SEPARATION

27954 (AEC-tr-4770) CONCENTRATION OF THE ARTIFICIALLY RADIOACTIVE URANIUM ISOTOPE $^{239}_{92}U$ AND ITS BY-PRODUCT $^{239}_{93}$ (ELEMENT 93). Kurt Starke. Translated by Gretchen R. Riese for Los Alamos Scientific Lab. from Naturwissenschaften, 30: 577-82(Sept. 18, 1942). 18p.

The separation or at least a concentration of U^{239} from irradiated uranium was attempted. A nucleus with an atomic number of 93 was obtained by beta decay of U^{239}. The detection of this element is described. A separation was obtained by the utilization of the recoil which the nuclei receive in their conversion. An attempt was then made to separate the radioactive atoms, remove from the complex by recoil, by extraction of a suitable solution of uranylbenzoylacetonate with $BaCO_3$ suspended in H_2O. The yield of U^{239} which could be obtained by this method consisted of about 10% of the entire amount formed. Properties of element 93, a decay product of U^{239}, are discussed. (M.C.G.)

27955 (AEC-tr-4775) SEPARATION OF ISOTOPES IN A CIRCULAR STREAM. H. J. Mürtz and H. G. Nöller. Translated for Oak Ridge Gaseous Diffusion Plant from Z. Naturforsch., 16a: 569-77(1961). 16p.

Centrifugal forces acting in a rotating gas are considered under conditions in which a gas mixture flows through a convergent nozzle at sound velocity tangentially into a pipe under low pressure. The dependence of the separation factor on the mass, the radius of the separating pipe, the diameter of the 'peeling' pipe, and of the nozzle length are discussed. Maximum separation factors are given. (J.R.D.)

27956 (AEC-tr-4780) A MULTIPLICATION EFFECT IN THE ENRICHMENT OF GERMANIUM ISOTOPES IN THE GAS CENTRIFUGE. V. Faltings and S. Seehoffer. Translated by Kurt H. Quasebarth for Univ. of Virginia from Z. Elektrochem., 57: 445-8(1953). 12p. (EP-4422-503-60U)

The separation of Ge isotopes is carried out in an ultracentrifuge rotating at 40,000 rpm. A mixture of GeH_4 and H_2 is introduced into the rotor, and the enrichment is found as a function of the total initial pressure, the initial mole % GeH_4 in the rotor, and the rate at which the centrifuged gas is tapped from the rotor. Effects that could increase the enrichment above the theoretically predicted value are discussed. (T.F.H.)

27957 (CEA-tr-X-369) PRODUCTION DE L'EAU LOURDE. (Production of Heavy Water). C. M. Santos Macedo. Translated into French from Eng. nuclear (Port.), No. 5, 80-3(1959). 21p.

Processes for the production of heavy water are based, in general, on differences in the physical properties of hydrogen and deuterium and on isotopic exchange. Processes utilizing these differences are tabulated and briefly discussed. The processes already used industrially or which show great promise—electrolysis process, distillation of water, distillation of hydrogen, and SH_2-H_2O dual temperature exchange—are reviewed. (J.S.R.)

27958 (CEA-tr-X-384) MÉTHODE DE FABRICATION DE L'EAU LOURDE. (Method for Separation of Heavy Water). H. V. Tuxen-Mayer. Translated into French from Danish Patent No. 86137. Sept. 1, 1958. 10p.

An economical method for the electrolytic separation of heavy water from natural water is given. The method is characterized by the fact that the hydrogen of the electrolysis apparatus is led to the negative pole and the oxygen in the apparatus is led to the positive pole. This process takes place in such a manner that the heavy water concentration continues to increase in the electrolysis apparatus. In addition all the energy loss is converted by a current source incorporated in series in the system. A second process, similar to the first but characterized by the fact that the electrolytic separation is combined with a separation by the diffusion principle, is given. (J.S.R.)

27959 AN AUTOMATIC CASCADE APPARATUS FOR PRODUCING HIGHLY ENRICHED N-15. I. G. Gverdtsiteli, Yu. V. Nikolaev, E. D. Oziashvili, K. G. Ordzhonikidze, G. N. Muskhelishvili, N. Sh. Kiladze, V. R. Mikirtumov, and Z. I. Bakhtadze. Atomnaya Energ., 10: 487-92(May 1961). (In Russian)

An automatic installation for N^{15} concentration by chemical exchange in NO—HNO_3 system is described. Concentrations of 99.8% N^{15} were prepared by ~0.5g nitrogen separation per day. The enrichment was achieved with natural N^{15} mixture of 0.365%. (tr-auth)

27960 SEPARATION OF NEON ISOTOPES BY THERMAL DIFFUSION. L. S. Kotousov, E. M. Martynov, and Yu. P. Stepanov. Atomnaya Energ., 10: 632-3(June 1961). (In Russian)

A cascade with a total length of 18 m consisting of six glass columns with a hot wire down the middle was constructed to produce 90% Ne^{22}. The average thermal-diffusion separation coefficient was 0.03; the temperature of the refrigerant was 280°K; the working pressure was 750 mm Hg; the diameter of the hot wire was 0.03 cm; the initial concentration of Ne^{22} was 10 at. % and the required concentration was 90 at. %. The internal diameter of the six consecutive sections of the column was reduced gradually for each section from 2.9 to 1.1 cm in order to decrease the time required in attaining steady-state operation. It required 15 days to reach steady-state. The maximum concentration of Ne^{22} was 99.97 at. %, while the over-all separation factor for the cascade was $\sim 6 \times 10^4$. Withdrawal of 90% Ne^{22} can be made at the rate of 200 cm^3/day with a concentration of 4 to 5 at. % Ne^{22} in the rejected portion (at an initial concentration of Ne^{22} of ~9.9 at. %). (TTT)

27961 THE SEPARATION OF HYDROGEN ISOTOPES ON A PALLADIUM CATHODE. G. N. Trusov, N. A. Aladzhalova, and V. I. Veselovskii (Karpov Inst. of Physics and Chemistry, [USSR]). Doklady Akad. Nauk S.S.S.R., 138: 1385-8(June 21, 1961). (In Russian)

The magnitude of the separation coefficient S for the separation of tritium and protium was investigated as a function of the properties of the surface layer of hydrogen on a palladium surface. The total overvoltage of the palladium was due to two components: an η_1 component which is the overvoltage due to the discharge stage of the hydrogen evolution and an η_2 component which is the overvoltage associated with the activity of hydrogen on the surface. If the palladium electrode is not subjected to strong oxidation by a preliminary anodic polarization, the value of η_2 is high (there is a significant amount of active hydrogen on the electrode), and the separation coefficient S varies from 6.5 to 11. With the application of an alternating current, the total overvoltage drops due to a decrease in the value of η_2, and the value of the separation coefficient S increases by

a unit or two to values varying from 7 to 12. With a further decrease in η_2, the values of S increase to 15 to 20. With an increase in temperature the value of S was found to fall in accordance with the expression $S = k \exp(\Delta E/RT)$. By freezing the electrode in liquid nitrogen and by analyzing the gas absorbed in the platinum and the gas in contact with the solution, it was found that the highest separation coefficients (8 to 20) were obtained for the hydrogen gas in contact with the solution near the electrode. The gas adsorbed by the electrode showed a low separation coefficient of 1 to 1.5. It is concluded that the main separation is obtained on breaking the H—OH bond at the electrode. (TTT)

27962 DAMPING MEANS FOR A VIBRATILE SHAFT, AND CENTRIFUGES AND LIKE ROTATING DEVICES INCORPORATING SUCH MEANS. (to United Kingdom Atomic Energy Authority). British Patent 876,364. Aug. 30, 1961.

A centrifuge is designed for separating gaseous isotopes and is adapted for operation at speeds as high as 470 rps. The centrifuge has a damping mechanism to prevent severe vibrating forces from building up in the bearings and supporting structures at critical speeds. The damping mechanism comprises movable and stationary sleeve members spaced apart and surrounding the shaft, and a body of fluid is maintained between the sleeve members. (D.L.C.)

MATHEMATICS AND COMPUTERS

27963 (GAMD-1027) S_n SLAB, N REGIONS. P. C. Kaestner (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Oct. 5, 1959. Contract AT(04-3)-187. 28p.

The Fortran listing, a sample input form, and the output corresponding to the input for calculating S_n slab, N regions are given. Also included are the differential equations, finite difference equations, auxiliary quantities, and operating instructions. (M.C.G.)

27964 (NP-10580) DIGITAL COMPUTER SOLUTION OF COMPLEX TRANSIENT HEAT TRANSFER PROBLEMS. J. T. Anderson (West Virginia. Univ., Morgantown); J. M. Botje (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati) and W. K. Koffel (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). [nd]. 27p.

Issued as: West V. Univ. Bull., Eng. Expt. Sta. Tech. Bull. No. 62.

A finite difference method was developed and programmed for a digital computer for solving complex transient heat transfer problems. Arbitrary geometrical configurations involving both solids and stagnant or flowing fluids are broken into as many as 200 nodes which exchange heat by convection, conduction, contact resistance, solid and gaseous radiation, surface flux and internal heat generation. Input consists of geometrical data, material identification, radiation configuration factors and boundary conditions. Boundary conditions may be specified as functions of either time or temperature. Material properties are stored internally as functions of temperature. The advantage of the backward time step pointed out by Liebmann assures convergence to an accurate solution without the usual restrictions for convergence that explicitly relate time and space increments when the forward time step is used. The basic equations are derived and methods for their solution are discussed. (auth)

27965 (NP-10600) COMPUTER PROGRAMS FOR X-RAY DIFFRACTION DATA PROCESSING. ONR Technical Report No. 33. R. S. Stein, J. Powers, and S. Hoshino (Massachusetts. Univ., Amherst). July 7, 1961. Contract 3357(00). 27p.

An IBM 1620 computer program was devised for correcting x-ray diffracted intensity data from oriented polymer films for background, polarization, absorption, and incoherent scattering. (D.L.C.)

27966 (SGAE-61/1B) DAS RECHNEN MIT DEM IBM-MAGNET TROMMELRECHNER TYPE 650. (Calculation with the IBM-Magnetic Drum Calculator Type 650). H. Bruneder and M. Fischer Colbrie (Osterreichische Studiengesellschaft für Atomenergie GMBH., Vienna). [nd.]. 15p.

An addition is presented for SGAE Report 61/1B. The purpose of the addition is to give a basis for other computer programs. (D.L.C.)

27967 (WAPD-TM-230) PDQ-4—A PROGRAM FOR THE SOLUTION OF THE NEUTRON-DIFFUSION EQUATIONS IN TWO DIMENSIONS ON THE PHILCO-2000. W. R. Cadwell (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 1961. Contract AT(11-1)-GEN-14. 50p.

PDQ-4 is a program for the Philco-2000 computer to calculate a discrete numerical solution to few group (≤ 4), time-independent, neutron-diffusion equations for heterogeneous reactors. The solution was obtained over a two-dimensional rectangular region in either Cartesian or cylindrical coordinates. The number of lethargy groups is limited to four and the number of points of solution is limited to 20,000. PDQ-4 is designed to operate in conjunction with the BKS sequencing system. The computer requirements include 8 or 16 index registers, at least 12 tape transports, and auxiliary card-to-tape and tape-to-printer equipment. A program description, input preparation, output, operating instructions, and sample problem are included. (M.C.G.)

27968 ON THE CONSTRUCTION OF TWO-DIMENSIONAL DIFFUSION PROCESSES SATISFYING WENTZELL'S BOUNDARY CONDITIONS AND ITS APPLICATION TO BOUNDARY VALUE PROBLEMS. Nobuyuki Ikeda. Mem. Coll. Sci., Univ. Kyoto. Ser. A., 33: 367-427(May 1961).

Path functions for 2-dimensional Markov-type diffusion processes are constructed by the method of stochastic integral equations. Diffusion on a disk is studied as an example. Several general boundary value problems that arise in this type of process are considered. (T.F.H.)

27969 ON THE RELATIVE EXTREMA OF THE TURAN EXPRESSION FOR BESSEL FUNCTIONS. S. K. Lakshmana Rao (Indian Inst. of Science, Bangalore, India). Proc. Indian Acad. Sci., Sec. A, 53: 239-43(May 1961). (In English)

The Bessel function $J_n(x)$, with $n \geq 0$ and x real, satisfies the inequality $\Delta_n(x) \geq [J_n(x)]^2/(n+1)$. The function $\Delta_n(x)$ is represented as an infinite sum in n and $J_n(x)$, having sequences of maxima and minima. The properties of these sequences are studied. In particular, it is proved that the r^{th} relative maximum of $\Delta_n(x)$ is greater than the r^{th} relative maximum of $\Delta_{n+1}(x)$. (T.F.H.)

27970 THE RACAH METHOD IN THE THEORY OF RELATIVISTIC EQUATIONS. L. A. Shelepin (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 40: 1369-83(May 1961). (In Russian)

The Racah technique is used to investigate the group properties of relativistically invariant equations of the type $\alpha_\sigma \partial_\sigma \psi + \mathfrak{K}\psi = 0$. The treatment presented here is a further development of previous work. A consistent method for determining the commutation relations which specify the algebra of the α matrices is given. The j-symbol and transformational matrix technique is used in the method. Some simple examples are the complete commutation relations for the Duffin-Kemmer equation of spin 1 and for the generalized Pauli-Fierz equation. A classification is made of covariants which comprise an $U(\alpha)$ algebra with respect to reflection and charge conjugation. Relations which can be used to express the infinitesimal matrix I_{ij} in terms of the matrix α are derived. The structure of the complete interaction Lagrangian is discussed. (auth)

27971 INTRODUCTION TO NONLINEAR DIFFERENTIAL AND INTEGRAL EQUATIONS. Harold T. Davis (Northwestern Univ., Evanston, Ill.). Sept. 1960. 581p. $2.00(GPO).

A comprehensive treatise is presented which defines the field of nonlinear problems from the physical point of view and indicates some of the progress attained in this field. Differential equations of first and second order are studied. Particular problems are considered, e.g., the Riccati equation, conflicting populations, pursuit, and the Duffing prob-

lem. Elliptic integrals, elliptic functions, and theta functions are treated. Emphasis is placed on the method of continuous analytic continuation. (D.L.C.)

27972 IMPROVEMENTS IN OR RELATING TO MAGNETIC MEMORY ELEMENTS. Ernest Franklin and Thomas Henry O'Dell (to United Kingdom Atomic Energy Authority). British Patent 875,192. Aug. 16, 1961.

A magnetic memory element for computers is described which has small delay time, low delta noise, and low drive power requirements. The element comprises a cylindrical drive conductor, a thin film of magnetic material on the conductor, and at least one transverse winding on the film. A matrix store of a plurality of such elements is also described. (D.L.C.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

27973 (BM-RI-5840) PREPARATION OF HIGH-PURITY NICKEL. K. K. Kershner, F. W. Hoertel, and J. C. Stahl (Bureau of Mines. Tuscaloosa Metallurgy Research Center, Ala.). Feb. 1961. 17p.

Nickel having a purity of more than 99.99% with reference to metallic impurities was electrodeposited. Procedures are outlined for purifying nickel solutions by precipitating and filtering off impurities. Details are given for using the purified solutions as electrolytes in depositing high-purity nickel. The electrodeposited nickel contained 0.0005 to 0.002% each of Co, Cu, and Fe together with spectrographically detectable traces of Al, Mg, and Si. The deposits were smooth and dense. Preliminary experiments for purifying nickel solutions by liquid-liquid extraction are also described. Sodium ethyl xanthate was used to precipitate Co and Cu from impure nickel amine solutions, and iron was separated as a hydroxide during the treatment. Tetraphenylarsonium chloride was used to precipitate cobalt ions complexed with thiocyanate from impure nickel solutions. Copper and iron were removed by precipitation and filtration under carefully controlled conditions. These contaminating ions were also separated effectively from impure nickel solutions by a cyclic procedure involving the use of sodium hypochlorite. Special precautions are outlined for preventing contamination and buildup of impurities in electrolytes. (auth)

27974 (MRL-97) AGING OF ELECTRODEPOSITED CHROMIUM. Kenneth A. Moon and Charles Levy (Watertown Arsenal. Materials Research Lab., Mass.). Aug. 1961. 27p.

Studies of a variety of chromium electrodeposits showed that changes in properties and composition occur during storage at room temperature. Deposits from chromic/chromous solution lost hydrogen and gained oxygen. The hydrogen loss was inhibited by absence of air. Deposits from the standard chromic acid bath lost hydrogen at widely different rates but did not absorb an appreciable amount of any other material. The observations were interpreted in terms of assumptions about the nature of the hydrogen and oxygen impurities in the deposits. (auth)

27975 (NMI-9515) BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report to Aeronautical Systems Division for the Period April 1, 1961 through June 30, 1961. S. H. Gelles (Nuclear Metals Inc., Concord, Mass.). Aug. 11, 1961. Contract AF33(616)-7065. 18p.

Summaries are presented of work done in studies of resistance welding techniques for producing crack- and void-free welds in 0.040-in. thick sheet, and resistance brazing techniques for 0.020-in. thick sheet. Discussions are given of work done in the distillation of beryllium, and the evaluation of the distilled material. During the evaluation, evidence was found of the existence of a second phase in the material, which is believed to be a strong contributing factor to the poor mechanical properties observed. (B.O.G.)

27976 (NP-10464) BASIC FACTORS IN THE FORMATION AND STABILITY OF NON-SOAP LUBRICATING GREASES FOR USE AT ELEVATED TEMPERATURES. Fourth Quarterly Progress Report, April 1, 1961 to July 1, 1961. (Lehigh Univ., Bethlehem, Penna. Inst. of Research). July 1961. Contract AF 33(616)-7120. 22p.

Monthly Report No. 14 is incorporated herein and will not be submitted separately.

A program was initiated to study the use of carbon black as a thickener in non-soap greases. Initial experimental results are promising. Blacks with areas greater than 100 m^2/g and low volatile content possess the most desirable properties according to tests run to date. Sufficient ion-incorporated silicas were prepared and subjected to stability tests in non-soap grease systems to definitely establish the enhancement of properties of the treated solids relative to the untreated silica. Such treated solids show great promise for use at elevated temperatures. (auth)

27977 (NP-10559) THERMOELECTRIC MATERIALS. Bimonthly Progress Report for December 1, 1960 to February 1, 1961. (Report No. 13). J. W. Johnson (Stanford Research Inst., Menlo Park, Calif.). Feb. 28, 1961. Contract NObs-77017. 10p.

Several compositions of the Cu_2Te-Cu_2S system were examined in both the liquid and solid state. Data obtained on the Seebeck coefficient and resistivity are given. Data on the thermal conductivity of Cu_2S up to 950°C were obtained using the Peltier method. The thermal-electrical contacts for the sample and the cylindrical side shield are described. It was decided to use the comparison method for the determination of thermal conductivity in the liquid state. (M.C.G.)

27978 (SCR-417A) A LOW-DENSITY POTTING COMPOUND. A. J. Quant (Sandia Corp., Albuquerque, N. Mex.). June 1961. First Revision Aug. 1961. 31p.

Preprinted for Second International Electronic Circuit Packaging Symposium, Bureau of Continuation Education, Univ. of Colorado, Boulder, Aug. 1961.

A combined total of 4 years development effort and production experience proved conclusively the value of a glass-microballoon-filled epoxy resin system in potting applications where weight saving, without a drastic sacrifice in physical properties, or resistance to high-level mechanical shock is a prime requirement. (auth)

27979 (NP-tr-698) FIAT REVIEW OF GERMAN SCIENCES 1939–1946 — GENERAL METALLURGY. (Selected Articles, 41-7; 125-45). Translated from a publication of the Publishing Office of the Kaiser-Wilhelm-Institut Fuer Metallforschung, Stuttgart. 42p.

Included are two articles concerning the elastic properties, and the plastic deformation and recrystallization of solids. (B.O.G.)

27980 (NP-tr-698(p.1-10)) GENERAL METALLURGY. II. ELASTIC PROPERTIES. W. Koester. p.41-7 of FIAT Review of German Science 1939–1946.

Investigations of the elastic properties of metals are reviewed, and discussed according to: the dependence of the modulus of elasticity on the concentration of metals in an alloy and test temperatures; the effects of the ferromagnetic state, and mechanical and thermal treatment on the modulus of elasticity; measurements of single crystals; general considerations; and determinations of the modulus. Tables are presented of the elastic properties of pure metals and mean temperature coefficient of the modulus of elasticity of pure metals from −180 to 1000°C. 26 references. (B.O.G.)

27981 (NP-tr-698(p.11-41)) GENERAL METALLURGY. V. PLASTIC DEFORMATION AND RECRYSTALLIZATION. A. Kocherdoerfer. p.125-45 of FIAT Review of German Science 1939–1946.

Investigations of plastic deformation, solidification, and recovery are discussed for homogeneous and inhomogeneous deformation of single crystals, deformation of polycrystals, the deformed state, and endurance limits of unidirectional and alternating stress. Recrystallization studies of unworked and worked bodies are reviewed. 107 references. (B.O.G.)

27982 PRODUCTION OF PLUTONIUM METAL. Elspeth W. Mainland, in collaboration with D. A. Orth, E. L. Field, and J. H. Radke (E. I. du Pont de Nemours & Co., Inc., Aiken, S. C.). Ind. Eng. Chem., 53: 685-94(Sept. 1961).

DuPont's experience in attaining successful operation of the three final steps of the Purex process in producing plutonium metal is discussed, and several years of operating experience are summarized. The equipment modifications and operating experience, safety, and dependability of equipment are given. Several flow diagrams and designs of equipment are shown. (P.C.H.)

27983 METALLURGY IN NUCLEAR POWER TECHNOLOGY. 5. FUEL ELEMENT CANNING MATERIALS. PART II. J. C. Wright. Metal Treatment and Drop Forging, 27: 511-17(Dec. 1960).

A review is given of methods used in the production and fabrication of beryllium, beryllium powder, niobium, and niobium powder. Properties of these materials are also given with particular attention placed on their fuel element canning properties. (N.W.R.)

27984 PREPARATION OF TECHNICAL ZIRCONIUM NITRIDES. K. I. Portnoi and Yu. V. Levinskiĭ. Zhur. Priklad. Khim., 34: 1413-18(July 1961). (In Russian)

A method is suggested for preparing zirconium nitride by nitriding wet zirconium powder, utilizing the heat of zirconium partial oxidation by water vapor. The product of wet powder heated in nitrogen at 450 to 600°C for 15 min contained 9.5 to 10.2 wt. % nitrogen. (R.V.J.)

27985 PREPARATION AND PROPERTIES OF YTTRIUM MONOCARBIDE. G. V. Samsonov, G. N. Makarenko, and T. Ya. Kosolapova (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukranian SSR). Zhur. Priklad. Khim., 34: 1444-8(July 1961). (In Russian)

Carbide reduction of yttrium oxide in a vacuum (Y_2O_3 + 5C = 2YC + 3CO) was utilized in preparing YC. The YC forms at 1900°C. The microhardness of the YC is 120 kg/mm^2, melting point 1950 ± 20°, specific resistivity 4 × 10^4 $\mu\Omega$ · cm, electromotive force 34.8 μv/C°, and the coefficient of thermal expansion is 1.36×10^{-1}/C°. The chemical stability was tested in various media. (R.V.J.)

27986 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF PETROLEUM COKE. (to Bataafse Petroleum Maatschappij N. V.). British Patent 875,114. Aug. 16, 1961.

A process is outlined for producing petroleum coke for conversion into reactor grade graphite. The process comprises treating a petroleum distillate with a O_2-containing gas at 175 to 400°C, distilling the resulting material, and subjecting the distillate to a thermal cracking treatment. The resulting petroleum coke may be graphitized using the distillation residue with a softening point (Ring and Ball method) of at least 80°C as a binder and densifier. (D.L.C.)

27987 IMPROVEMENTS IN OR RELATING TO THE PROTECTIVE TREATMENT OF GRAPHITE. Terence Glanville and James Glinn (to United Kingdom Atomic Energy Authority). British Patent 876,091. Aug. 30, 1961.

A method is described for increasing the oxidation resistance of a shaped graphite body. The method comprises impregnating the graphite body with an organic solution of phosphorus pentoxide or of phosphorus pentoxide and a tetraalkyl silicate, and then heating the graphite to above the composition temperature of the compounds. The method may also be applied to graphite powder. (D.L.C.)

27988 PRODUCTION OF METALS. Frank H. Spedding, Harley A. Wilhelm, and Wayne H. Keller (to U. S. Atomic Energy Commission). U. S. Patent 3,000,726. Sept. 19, 1961.

A process is described producing metallic thorium, titanium, zirconium, or hafnium from the fluoride. In the process, the fluoride is reduced with alkali or alkaline earth metal and a booster compound (e.g. iodine or a decomposable oxysalt) in a sealed bomb at superatmospheric pressure and a temperature above the melting point of the metal to be produced.

Corrosion

27989 (APAE-82) EVALUATION OF KANIGEN, ELECTROLESS NICKEL PLATING FOR STEAM SIDE OF A SODIUM COMPONENT STEAM GENERATOR. (Alco Products, Inc., Schenectady, N. Y.). Feb. 15, 1961. Contract AT(11-1)-666. 40p.

The evaluation of Kanigen electroless nickel plating for surfaces in contact with water and steam in a sodium-heated Type 316 stainless steel steam generator is reported. The purpose of the coating is to afford protection from stress corrosion cracking originating on the water–steam side of the unit. It is concluded that the Kanigen coating does not afford adequate protection for the service conditions. (D.L.C.)

27990 (CVNA-87) CONOSEAL GASKET CREVICE CORROSION STUDY; CVTR PROJECT. Terminal Report. C. J. Kubit (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). [nd]. For Carolinas-Virginia Nuclear Power Associates, Inc. Contract AT(30-1)-2289. 40p.

Zircaloy-2 to AISI type 410 gasketed joints were corrosion tested in simulated CVTR coolant water for periods up to 180 days at 300 and 567°F. Special emphasis was placed on testing for possible crevice corrosion effects. Neither serious general corrosion nor pitting was observed on the test specimens. (auth)

27991 (DMIC-Memo-120) REVIEW OF RECENT DEVELOPMENTS ON OXIDATION-RESISTANT COATINGS FOR REFRACTORY METALS. W. D. Klopp (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 31, 1961. 6p.

A review is presented of developments in aluminum-alloy and silicide coatings for molybdenum, niobium, tantalum, and tungsten. 11 references. (B.O.G.)

27992 (HW-67818(Rev.)) MULTIPLE RATE TRANSITIONS IN THE AQUEOUS CORROSION OF ZIRCALOY. B. Griggs, H. P. Maffei, and D. W. Shannon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1960. Contract AT(45-1)-1350. 24p.

The weight gain of Zircaloy-2, -3, and low nickel Zircaloy-2 during water and steam corrosion is shown to go through two or more repetitive cycles. It is assumed the weight gain curves truly represent the corrosion kinetics. Several corrosion mechanisms are considered in the light of the kinetics. No definite mechanism can be established as correct with the present data; however, a supposition that stresses in the film periodically cause it to crack at or near the oxide-metal interface appears consistent with the data. (auth)

27993 (HW-68738) CORROSION OF VARIOUS METALS AND ALLOYS BY PHOSGENE, HYDROGEN CHLORIDE, AND CARBON TETRACHLORIDE AT 400–600C. W. L. Walker (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1, 1961. Contract AT(45-1)-1350. 14p.

Of the materials investigated, Hastelloy B and Hastelloy C appeared to be most suitable for service where using phosgene or carbon tetrachloride as the chlorinating agent. These alloys exhibited corrosion rates of 0.2 to 11 mils penetration per month at 400 to 600°C. Haynes 25 and Chlorimet 2 exhibited corrosion rates nearly identical with the Hastelloys. However, the initial cost expense of Haynes 25 is about twice that of the Hastelloys. Chlorimet 2 is available only in the cast form and has undesirable mechanical properties. Commercially pure nickel exhibited corrosion rates similar to the Hastelloys, but nickel contamination of the product is a problem. Planinum, gold, and Baker 413 (a gold-platinum-palladium alloy) were severely attacked by the phosgene system and were considered unsuitable for the carbon tetrachloride system because of the possibility of phosgene formation. However, in the hydrogen chloride system, the precious metals and Baker 413 exhibited corrosion rates of 0.01 to 0.4 mils penetration per month at 400 to 600°C. A variety of metals and alloys were exposed to the off-gas stream from the phosgene system. Severe corrosion occurred when the sample temperatures were low enough to permit condensation. (auth)

27994 (LMSD-895073) HIGH TEMPERATURE CORROSION OF BERYLLIUM IN AIR. W. Bradshaw and E. S. Wright (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Jan. 1961. 70p.

Experiments using either a manometric or a gravimetric technique demonstrated that the reaction in air approaches a linear rate of $n = 1$ in the rate law equation. Detailed analysis showed that under isothermal conditions, n fluctuates from a semiprotective reaction ($n = 0.9$) to a moderately accelerated reaction ($n = 1.2$). An induction period was observed in all experiments carried out in air. The mechanism is temperature dependent (the activation energy is 30 kcal/mole) and unaffected by pressure in the range 0.6 – 1.0 atmospheres. The induction period is lowered as a function of temperature by heat treatment at less than 10^{-3} atmospheres, but the energy of activation for the process remains unchanged. Metallographic analysis indicates that below 1050°C the reaction is accompanied by intergranular penetration, but that above 1250°C the reaction proceeds by total corrosion at the specimen surface. Both x-ray and metallographic analysis indicate the possibility of a high-temperature corrosion product different from normal beryllium oxide or beryllium nitride. Anodized Be undergoes a complex process of corrosion in air in which spherical blisters form in the coating; the reaction proceeds by lateral as well as vertical growth. (auth)

27995 (NAA-SR-5928) MOLTEN PHOSPHATE REACTOR FUELS. IV. IN SITU CORROSION STUDIES OF METALS IN MOLTEN SODIUM POLYPHOSPHATE. L. F. Grantham, T. L. Young, M. A. Hiller, and W. S. Ginell (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 15, 1961. Contract AT(11-1)-8. 20p.

The corrosion rate of iron and Inconel in molten sodium polyphosphate was followed by a mass spectrometric determination of the evolution rate of phosphorus. Two mechanisms appear to control the rate of corrosion: the diffusion of reactants through the protective phosphide film that forms on the surface of the metal; and the depletion of a reactive phosphate species from the melt. This species, possibly $Na_3P_3O_9$, does not appear to be replenished very rapidly through reorganization of the long chain phosphates. The corrosion rate decreases several hundredfold with time, indicating that corrosion in a fused phosphate reactor is probably controllable. (auth)

27996 (NP-10541) HYDROGEN AND THE CORROSION OF URANIUM AND OTHER OXIDE COVERED METALS. Period covered: October 1958–September 1960. J. S. Llewelyn Leach (Imperial Coll. of Science and Tech., London). Sept. 1960. Contract CON/RIS/22158. 69p.

The model of the corrosion process in oxide-covered metals which is being developed suggests that the electronic conductivity of the oxide plays a much greater part than was previously believed. The dependence of this conductivity on the presence of hydrogen in the oxide appears to be most important in explaining corrosion rates and hydrogen pick-up during corrosion of oxide covered metals and alloys. The effects of alloying of oxide-covered metals on the corrosion rate were studied. Results are given for optical, electrical, and overvoltage studies. (M.C.G.)

27997 (NP-10542) HYDROGEN AND THE CORROSION OF URANIUM. First Biennial Report, July 1958. J. S. Llewelyn Leach (Imperial Coll. of Science and Tech., London). Contract N 62558(24)-1177.

The effects of hydrogen on the corrosion of uranium were studied. The effect on mixed corrosion potential of hydrogen in solution in the metal was determined by studying the potential difference developed between a corroding specimen and a standard electrode in a galvanic cell. The hydrogen overvoltage and its variation with current were investigated. The electrical capacity and resistance of the oxide layer were measured by treating the oxide covered electrode as a leaky condenser. It was found that hydrogen in solution in uranium can increase the corrosion rate. The mechanism by which this occurs appears to be the ability of hydrogen to increase the conductivity of the protective oxide film without changing the thickness. The nature of this increased conductivity may be related to a change in the ionic species in the oxide. (M.C.G.)

27998 (CEA-tr-X-380) OXYDATION À CHAUD PAR LA VAPEUR D'EAU, DU ZIRCONIUM ET DE SES ALLIAGES. (Oxidation by High-Temperature Steam of Zirconium and its Alloys). T. Maekawa and J. Kai. Translated from Nippon Kinzoku Gakkaishi, 24: 581-4(1960). 27p.

The rates of oxidation and hydrogen absorption of iodide zirconium, commercial-grade zirconium, Kroll-processed reactor-grade zirconium, its 2.5% tin alloy, and its 0.24% iron alloy were measured in water vapor over the temperature range 650 to 850°C. The results show that there was no great difference between the oxidation rates in water vapor and in oxygen. The percentage of absorbed hydrogen in the samples oxidized with water vapor was 1 to 20% of the hydrogen produced by the oxidation process and decreased as the temperature became higher. The amounts of absorbed hydrogen were larger in samples with higher oxidation rates than in those with lower oxidation rates. (auth)

27999 (NP-tr-703) HIGH-TEMPERATURE OXIDATION OF ALLOYS WITH HIGH MELTING POINT. INSTALLMENT II. ALLOYS OF TUNGSTEN WITH ZIRCONIUM. R. F. Voytovich. Translated from Fiz. Metal. i Metalloved., 10: 862-5(1960). 5p.

Studies were made of the kinetics of high-temperature oxidation of alloys of tungsten with zirconium. The sinter formation in these alloys was studied in the temperature interval from 500 to 900°. It was found that the addition of

tungsten increased the hardness of the alloys. All the alloys oxidized more intensely than the pure metals. The breakdown, which is characteristic of the temperature dependence of the rate of oxidation of tungsten, and connected with the appearance in the oxidized layer of the activating phase of α-WO_3, was observed only in alloys with a greater content of tungsten. (M.C.G.)

28000 CORROSION OF METALS IN AN EXPERIMENTAL CHANNEL IN THE IRT REACTOR. A. V. Byalobzheskii and V. D. Val'kov. Atomnaya Energ., 10: 525-8(May 1961). (In Russian)

The behavior of cathodic corrosion couples of Zr–Al, Zr–Fe, and Fe–Al in 0.05N NaCl solution under a thermal neutron flux of $\sim 2 \times 10^{12}$ n/cm^2 sec was investigated. The variations in the corrosion couple current density, and the electrolyte temperature are plotted as functions of the cell time and place in the reactor and thermostat. The curves of the metal polarization in 0.05N NaCl solution at 25°C are analyzed. (R.V.J.)

28001 HIGH TEMPERATURE SCALING OF HAFNIUM IN AIR. John D. Gadd (Thompson Ramo Wooldridge, Inc., Cleveland) and Edward B. Evans. Corrosion, 17: 441t-5t (Sept. 1961).

The scaling behavior of hafnium in air was studied in the temperature range of 600 to 1200°C. Hafnium initially scaled at a rate between parabolic and cubic, followed by a transition to a much faster rate because of scale cracking. The transition phenomenon was associated with a change from a compact black scale to a porous white scale. Nitrogen, in the presence of oxygen, was responsible for transition by a mechanism which may involve crystal structure and compositional changes in the scale during scaling. The scaling behavior of hafnium and zirconium in air was found to be almost identical except that the latter exhibited growth whereas the former was dimensionally stable. (auth)

28002 THE CORROSION RESISTANCE OF MAGNESIUM AND ITS ALLOYS IN NUCLEAR ENGINEERING ENVIRONMENTS. P. E. Gallant. Corrosion Prevent. & Control, 6: No. 10, 42-5(Oct. 1959).

The corrosion resistance of magnesium and its alloys in nuclear environments is shown to be satisfactory. Since the metal has a high resistance to oxidation, it is suitable for use as a canning material in gas cooled reactors. Magnesium is also a low neutron absorbant and is compatible with fuel and coolant at operating temperatures. The metals have a slow rate of oxidation in dry oxygen and the resultant surface film of oxide is protective up to about 500°C. The behavior of the metals to carbon dioxide is similar to that of oxygen and only slight traces are found in the corrosion product in the presence of a dry atmosphere. (N.W.R.)

28003 FORMATION AND CONTROL OF TURBIDITY IN ALUMINUM–WATER REACTOR SYSTEMS. S. R. Hatcher and H. K. Rae (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Sci. and Eng., 10: 316-30(Aug. 1961).

The formation of a colloidal suspension of hydrated aluminum oxide (Gibbsite or α-$Al_2O_3 \cdot 3D_2O$) in the heavy water of the NRU reactor is described, and compared with turbidity formation in other aluminum-water reactor systems. The observed corrosion rate of aluminum is consistent with a mass transfer mechanism involving the continuous dissolution of the corrosion product film. Two primary mechanisms for removing the dissolved aluminum from solution are postulated. These are direct crystallization onto deposits in the heat exchangers and direct crystallization onto Gibbsite particles in the water. The former effectively removes alumina from the system while the latter produces turbidity in the water. The rate of appearance of turbidity depends on its rate of formation and its rate of removal by the purification system. Turbidity is removed by filtration and adsorption in the ion-exchange columns and by evaporation. It is desirable to reduce the rate of formation of turbidity by choosing water conditions that minimize the solubility of the corrosion product film, rather than by controlling the turbidity level by an adequate purification capacity. (auth)

28004 DYNAMIC CORROSION TESTS IN WATER AND STEAM FROM A DEVELOPMENT PROGRAMME FOR POWER REACTORS. F. Müller. Sulzer Tech. Rev., 42: No. 4, 45-51(1960).

A description is given of a test rig constructed by Sulzer Brothers for the investigation of corrosion problems arising in connection with nuclear power reactors. (auth)

28005 STUDIES ON THE MECHANISM OF THE ELECTROCHEMICAL CORROSION OF TITANIUM. III. THE CORROSION AND ELECTROCHEMICAL BEHAVIOR OF TITANIUM AND OF ITS PLATINUM AND PALLADIUM ALLOYS IN SULFURIC AND HYDROCHLORIC ACID SOLUTIONS. N. D. Tomashov, G. P. Chernova, and R. M. Al'tovskii (Inst. of Physical Chemistry, Academy of Sciences, USSR). Zhur. Fiz. Khim., 35: 1068-77(May 1961). (In Russian)

The cathodic and anodic potentiostatic polarization curves of titanium and its alloys in sulfuric and hydrochloric acid solutions were investigated. It is shown that an increase in acid concentration causes an increase in the passivation current and a shift of the total passivation potential in the direction of positive values. An increase in temperature has the same effect. The cathodic hydrogen overvoltage is considerably lower (by 350–400 mv) for platinum and palladium alloys of titanium. As a result the steady state potential of the alloys undergoes a positive shift falling in the region of partial or complete passivation of titanium. The latter circumstance considerably increases the corrosion resistance of titanium alloys with platinum and palladium (1–2%). (tr-auth)

28006 KINETICS OF THE ANODIC ELECTROLYTICAL OXIDATION OF TUNGSTEN. V. A. Lavrenko (Inst. of Metal–Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Zhur. Fiz. Khim., 35: 1095-1102(May 1961). (In Russian)

Kinetics of the anodic oxidation of high purity tungsten (99.989% W) in the recrystallized and cold worked states in 30% sulfuric acid was studied by the charge curve and polarization curve methods. Under the experimental conditions (anodic current density up to 50 ma/cm^2, temperatures 10 to 40°C) it was found that cold working considerably increases the rate of the oxidation process. Kinetic equations were derived, correlating the constant rate of change of potential and unitary rate of formation of tungsten oxides with the anodic current density. A relation was also found between the unitary rate of formation and anodic current values and the effective field of formation. The values of parameters were obtained, permitting calculation of the activation energy barrier of the oxidation reaction for the recrystallized and cold worked tungsten. (tr-auth)

Fabrication

28007 (AMC-TR-7-775(IV)) COLUMBIUM AND COLUMBIUM ALLOY EXTRUSION PROGRAM. PHASE III: DEVELOPMENT OF THE EXTRUSION OPERATION. In-

terim Report IV, February 28, 1961—August 28, 1961. J. S. Clark (Du Pont de Nemours (E. I.) & Co. Pigments Dept., Wilmington, Del.). Aug. 28, 1961. Contract AF33(600)-40700. 84p.

The development program on the hot extrusion of D-31 (Nb—10 Ti—10 Mo) "T" sections is described. Satisfactory dimensional tolerances and surface finishes were produced by extruding at 3200°F using glass lubrication and ceramic-coated dies. The principal problem encountered was breakage of the die during extrusion. (auth)

28008 (ANL-6384) DEVELOPMENT OF A PROCESS FOR SODIUM BONDING OF EBR-II FUEL AND BLANKET ELEMENTS. Edmund S. Sowa and Edward L. Kimont (Argonne National Lab., Ill.). July 1961. Contract W-31-109-eng-38. 22p.

Procedures for assembling EBR-II fuel elements with annular sodium bonds between the uranium rods and the stainless steel claddings are outlined. The results of several meltdown and uranium-settling experiments are given. Bonding experiments were performed: furnace bonding, submerged canning, ultrasonic bonding, centrifuging, pressure pulsing, and vibratory bonding. Vibratory bonding was chosen for the production of the first EBR-II core. (D.L.C.)

28009 (ASD-TR-7-886(I)) DEVELOPMENT OF 2400°F FORGING DIE SYSTEM. Interim Technical Progress Report, March 28—June 27, 1961. J. T. Berry, A. Murphy, T. Watmough, and P. R. Gouwens (Illinois Inst. of Tech., Chicago. Armour Research Foundation). July 1961. Contract AF33(600)-42861. 41p.

The development of a heating system for a 2400°F die forging system is described. The hot die configuration was redesigned for single-step extrusion forging to the final shape. Possible materials for successful 2400°F forging and evaluation methods are discussed. The goal is hot die forging of refractory metals. (D.L.C.)

28010 (CF-61-4-69) EVALUATION OF ELECTROLESS NICKEL BRAZED TUBE BUNDLES—METALLOGRAPHY REPORT NO. 387. R. S. Crouse (Oak Ridge National Lab., Tenn.). Apr. 26, 1961. 14p.

The metallographic evaluation was made of a bundle of six tubes fabricated using the procedures outlined for fuel bundle fabrication for the Yankee Power Reactor. Bond strengths were determined for three bonds in the two assemblies tested. Both assemblies showed completely cracked joints with continuous networks of Ni—P phase such as is known to cause a weak joint. Accurate fixturing and careful control of phosphorus content of the electroless nickel plating are indicated as means for obtaining substantial improvements in the brazed joints. (B.O.G.)

28011 (CF-61-7-24) PROGRESS REPORT ON BRAZING OF COLUMBIUM. C. W. Fox and R. G. Gilliland (Oak Ridge National Lab., Tenn.). July 5, 1961. 20p.

The investigation of procedures and the development of alloys for brazing niobium are discussed. A survey of binary phase diagrams reveals that the most promising brazing alloy system for experimental investigation lay in the titanium- and zirconium-base alloys. The preliminary evaluation of a large number of refractory-metal brazing alloys indicated that one binary, nine ternary, and two quaternary compositions show considerable potential for high-temperature service. (auth)

28012 (GEAP-3591) MANUFACTURE OF THE ADHESIVE BONDED AEC SUPERHEAT CRITICAL FUEL. W. R. Raymont and D. T. Daniels (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Dec. 9, 1960. Contract AT(04-3)-189. 38p.

A bayonet-type two-pass fuel element for an A.E.C. Superheat Critical Fuel experiment is designed with adhesive bonded joints between aluminum fittings and stainless steel tubular parts. An investigation of the physical properties of joints prepared by adhesive bonding is conducted. (auth)

28013 (GEAP-3623) SWAGING OVER UNGROUND PELLETS. R. L. Brown (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Jan. 25, 1961. Contract AT(04-3)-361. 11p.

Stainless steel tubes of various wall thicknesses were swaged over UO_2 pellets of different size ranges. The swaging was calculated to bring the tubes into contact with the pellets. The strength of the 0.017-in. wall tubes was not affected. The strength of the 0.010-in. wall tube was decreased when swaged over pellets that varied in size by ±0.008 in. The strength of the 0.006-in. wall tube was decreased when swaging over pellets that varied in size by ±0.005 in. (auth)

28014 (NP-10407) DEVELOP PROCESS FOR AN ARC CAST 25 TO 50 POUND INGOTS OF TIN REDUCED MOLYBDENUM. Monthly Progress Reports, April 7, 1958 to May 31, 1961. (Oregon Metallurgical Corp., Albany). 272p.

28015 (NP-10576) ELECTRODEPOSITION OF EROSION AND OXIDATION RESISTANT COATINGS FOR GRAPHITE. Quarterly Progress Report, February 23, 1961—May 23, 1961. C. H. Wright, G. F. Bargero, and J. Huminik, Jr. (Value Engineering Co., Inc., Alexandria, Va.). June 15, 1961. Contract NOw-61-0670. 38p.

Activities in a program to develop coatings to reduce or eliminate erosion in rocket nozzles are described. A formal literature search revealed that successful electrodeposition of cermet coatings on graphite or other nonmetallic materials has not been reported. However results of work in the project indicate that electrodeposition is a very adaptable method for incorporating protective coatings on high temperature graphite rocket nozzles. Plans for future work are included. (J.R.D.)

28016 (NP-10672) OXIDATION RESISTANT HIGH TEMPERATURE PROTECTIVE COATINGS FOR TUNGSTEN First Quarterly Progress Report, May 1, 1961 to July 31, 1961. H. J. Nolting and R. H. Burgess (Thompson Ramo Wooldridge Inc., Cleveland). Aug. 15, 1961. Contract AF 33(616)-8188. 50p. (TM-3056-67)

A preliminary investigation was made of the deposition of zirconium on tungsten as a basis for the formation of a metal bonded-metal modified oxide protective coating. The study included the consideration of intermediate layers between the zirconium and tungsten to increase the zirconium deposition rate and promote diffusion bonding with the tungsten substrate. Oxide conversion techniques were investigated for converting the outer region of the zirconium layer to metal modified zirconia. A discussion is presented of the design, construction, and proposed use of the 3800°F air oxidation and vapor phase oxide reaction furnaces. (auth)

28017 (NYO-9588) APPLICATIONS OF ULTRASONIC ENERGY. TASK 5: DEVELOPMENT OF ULTRASONIC ROLL-BOND CLADDING FOR PLATE-TYPE FUEL ELEMENTS. Quarterly Report No. 1, Covering Period from November 1, 1960 to February 1, 1961. (Aeroprojects, Inc., West Chester, Penna.). Feb. 1961. Contract AT(30-1)-1836. 28p.

Initial exploratory work in edge-cladding of cores and simulants with multiple layers of successively overwelded foil showed that tensile strengths averaging 70% of that of the cladding material are obtained. The foil-laminate cladding may be applied more readily than rails or plates be-

cause of the lower power, lower clamping forces, and higher speeds required. Techniques were tentatively worked out for complete cladding of cores by the foil-laminate method. The blistering of the clad cores after annealing remains a problem, especially with laminated-foil face cladding and plate-type face claddings. It is considered that the damage caused by blistering is not as critical for foil-laminate clad cores as it is for plate-clad cores since the core is less likely to become exposed. Isolation of the cause of blistering by controlling known variables is being rigorously investigated. (auth)

28018 (CEA-tr-R-1333) CERTAINES RÉGLES DE FRITTAGE DES POUDRES DE COMPOSÉS RÉFRACTAIRES PAR COMPRESSION À HAUTE TÉMPERATURE. (Certain Rules in Fritting Refractory Compounds with Compression at High Temperature). M. S. Kovaltchenko and G. V. Samsonov. Translated into French from Izvest. Akad. Nauk S.S.S.R., Ser. Tekh. Met., 4: 143-7(1959). 20p.

Investigations on the laws of agglomeration by compression at high temperatures were made on powders of the carbides of Ti and W and on the borides of Ti, Zr, and Mo. The size of the powder particles was 5 to 8 μ. The ratio of the density of the agglomerate samples to the value of the exterior pressure at temperatures between 1900 and 2600°C was determined, and at low pressures a linear dependence of the density on the pressure was observed. At higher pressures each isotherm has a curvature inflection after which the increase of density and pressure is sharply delayed by conserving the rectilinear character of the ratio. An examination of shrinkage during agglomeration shows that the most important shrinkage occurs the first few seconds after the application of pressure. The last shrinkage step is characterized by a very slow increase of the density. After shrinkage, slow processes of flow diffusion occur. A study of the influence of temperature on density shows rapid evolution of the density at temperatures from 1700 to 2000°C; the density increases then slows. At sufficiently high temperatures, materials similar to metallic alloys reveal properties of elasticity and viscosity, decreasing with decrease of temperature. (J.S.R.)

28019 ELECTRO-EROSION MACHINING OF METALS. A. L. Livshits. Translated by E. Bishop—R. S. Bennett, ed. London, Butterworths, 1960. 123p. $5.75.

Description is given of the technique, technology, and industrial uses of electro-erosion machining. Greatest importance is placed on the electro-pulse methods which have better technical and cost characteristics and a wider field of application than the electro-spark. Among the various uses of electro-pulse machining, descriptions are given mainly of the more thoroughly investigated copy-drilling applications, which have proved the most difficult to get into operation, but the most versatile in technological capabilities. (N.W.R.)

28020 IMPROVEMENTS IN OR RELATING TO WELDING. Norman Frank Eaton (to United Kingdom Atomic Energy Authority). British Patent 874,112. Aug. 2, 1961.

An arc welding method is described in which an arc is struck between an electrode and a weld puddle on a workpiece. A stream of inert gas is supplied at the point of welding to shield the weld puddle from the atmosphere surrounding the weld puddle. An annular second stream of inert gas is supplied to an area of the workpiece surrounding the weld puddle. The temperature of the annular stream is sufficiently high and the area is sufficiently large to reduce the temperature gradient from the weld puddle to the workpiece and prevent subsequent cracking of the weld. (N.W.R.)

28021 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF HOLLOW BODIES FROM METAL POWDER. Thomas James Davies (to United Kingdom Atomic Energy Authority). British Patent 874,129. Aug. 2, 1961.

A method is described for loose-sintering metal powder to form hollow bodies in which the likelihood of cracking during sintering and cooling is reduced. The method consists of loose-sintering the metal powder about a supporting core in a mold. The mold is of hollow cylindrical form and the core is in the form of a longitudinally corrugated thin walled tube and is of readily contractible material to accommodate shrinkage. The core is of wire gauze and is externally coated with a refractory oxide so as to present a smooth outer surface and thereby enable the production of a smooth bored tubular body. Axial end loading is applied to the sleeve of wire gauze so as to provide a regulated radial support for the tubular body during the sintering. Beryllium powder may be formed in this manner at 1200°C. (N.W.R.)

28022 IMPROVEMENTS IN OR RELATING TO WELDING. Norman Frank Eaton (to United Kingdom Atomic Energy Authority). British Patent 875,035. Aug. 16, 1961.

An improved d-c arc welding process is described which uses ultrasonic vibrations to cause breakup of oxide films at the welding point and to improve the mechanical properties of the weld by refining the weld grain structure. The ultrasonic vibrations are induced in the molten weld region by contact with a wire attached to a transducer. (D.L.C.)

28023 IMPROVEMENTS IN OR RELATING TO BRAZING. Philip Ross Simpson (to United Kingdom Atomic Energy Authority). British Patent 875,231. Aug. 16, 1961.

A method of preparing components for brazing is described which can be applied to the assembly of the components to form an article involving the sliding of one component into slots in other components. The method comprises attaching a brazing foil over the surface of one component and applying pressure, e.g., rolling, to render the foil flush with the surface. The use of the method in the fabrication of a reactor fuel element comprising spaced fuel plates brazed in a hollow container is described. (D.L.C.)

28024 HOT PRESSING TO FORM CANNED URANIUM SLUGS. W. E. Kingston and S. B. Roboff (to U. S. Atomic Energy Commission). U. S. Patent 2,993,786. July 25, 1961.

A method of making compacts and clad slugs from powdered uranium is disclosed. Powdered uranium is introduced into a die and subjected to pressures of 30 to 100 tsi while maintaining a temperature within the range of 450 to 660°C. (auth)

28025 METHOD OF MAKING METAL BONDED CARBON BODIES. Walter V. Goeddel and M. T. Simnad (to U. S. Atomic Energy Commission). U. S. Patent 3,001,238. Sept. 26, 1961.

A method of producing carbon bodies having high structural strength and low permeability is described. The method comprises mixing less than 10 wt.% of a diffusional bonding material selected from the group consisting of zirconium, niobium, molybdenum, titanium, nickel, chromium, silicon, and decomposable compounds thereof with finely divided particles of carbon or graphite. While being maintained at a mechanical pressure over 3,000 psi, the mixture is then heated uniformly to a temperature of 1500°C or higher, usually for less than one hour. The resulting carbon bodies have a low diffusion constant, high dimensional stability, and high mechanical strength.

Properties and Structure

28026 (AFOSR-TN-59-561) LIQUIDS FOR USE IN LARGE BUBBLE CHAMBERS. B. Hahn, G. Riepe, and A. W. Knudsen (Fribourg, Switzerland. Universite). [1959]. 9p. (AD-253122)

The pure liquids C_3F_8, C_4F_{10}, SF_6, C_2ClF_5, $CBrF_3$, and TeF_6, as well as binary mixtures of the substances, were found to have very desirable properties for use in large bubble chambers for studying decay modes of elementary particles. (auth)

28027 (APAE-83) SUITABILITY OF INCONEL FOR CORROSION PROTECTION ON WATER SIDE OF SODIUM COMPONENT STEAM GENERATOR. Laurence E. Phillips and Frank F. Vawter (Alco Products, Inc., Schenectady, N. Y.). Mar. 1, 1961. Contract AT(11-1)-666. 18p.

The heat exchanger and steam generator for the U. S. Atomic Energy Commission Sodium Components Project will be constructed entirely of type 316 stainless steel. Because of the susceptibility of this alloy to stress corrosion cracking, it is proposed to clad all areas of the steam generator with Inconel where the stainless steel will be exposed to water and steam. A discussion is presented of the work to justify the selection of Inconel for this service. A discussion of Inconel type welding alloys is also included. (auth)

28028 (APEX-637) URANIUM–BERYLLIUM–HYDROGEN SYSTEMS; AN EXPERIMENTAL STUDY. D. H. Fraembs (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). June 7, 1961. Contracts AF33 (600)-38062 and AT(11-1)-171. 40p.

Measurements were made on subcritical and critical assemblies designed to furnish information necessary to determine optimum safe masses and atomic ratios of uranium, beryllium, and hydrogen as applied to the ceramic fuel production areas. The experimental results indicate that mixtures of water with U^{235} are more reactive then mixtures of beryllium oxide, water, and U^{235} within the range of conditions observed in the laboratory. Thus, current limitations which are in effect in handling uranium–beryllium–hydrogen mixtures might possibly be relaxed without compromising safety. (auth)

28029 (ASD-TR-7-782(V)) THE DEVELOPMENT OF OPTIMUM MANUFACTURING METHODS FOR COLUMBIUM ALLOY FORGINGS. Interim Technical Engineering Report, March 15, 1961–August 15, 1961. R. O. Carson (Crucible Steel Co. of America. Midland Research Lab., Penna.). Aug. 1961. 91p.

Of the four alloys evaluated, F48 (Cb–15W–5Mo–1Zr), Cb74 (Cb–10W–5Zr), D41 (Cb–20W–10Ti–6Mo) and D31 (Cb–10Ti–10Mo), alloy Cb74 offers the best combination of hot strength, ductility, and forgeability for the production of closed die forgings. The superior forgeability and better room temperature ductility of Cb74 more than compensate for its lower strength when compared to F48. Good quality extrusions were made at 2200-2300°F from ingots of the four alloys which had been canned in mild steel. Relatively high extrusion pressures were required except for D31 and the press stalled during the extrusion of one of the F48 ingots. Upset forging tests were made on annealed pieces of the extrusions at three temperatures using 50% upset in one heat and 75% upset in two heats. Subsequently, mechanical properties were determined. In summary, alloy Cb74 was best. Shortcomings of other alloys were: D31 — lowest hot strength, D41 — shallow forging cracks, room temperature brittleness, low hot strength, F48 — slight forging cracks from the lower temperatures, low ductility as annealed though considerably improved by 1400°F vacuum anneal. Oxidation resistance comparisons varied widely between alloys depending on temperature, all need coatings. An advantage for F48 was appreciably higher hot strength. Stress rupture strength in range 2000-2600°F was 50% higher than for Cb74. (auth)

28030 (AWRE-O-36/61) STUDIES OF ALLOYS OF PLUTONIUM WITH TRANSITION ELEMENTS AND GOLD. R. G. Cope, J. N. Lowe, and D. C. Miller (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Aug. 1961. 17p.

A preliminary investigation of the constitution and stability of alloys of Pu with some of the transition elements and with Au was made. Dilatometric, thermal analysis, and metallographic methods were used, and in the case of the Pu–Ru system a partial equilibrium diagram up to 25 at.% Ru is proposed. (auth)

28031 (DP-589) METALLOGRAPHY OF U–2 WT.% Zr ALLOY BEFORE AND AFTER IRRADIATION. C. L. Angerman and W. R. McDonell (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). July 1961. Contract AT(07-2)-1. 22p.

Optical and electron metallography and electron diffraction were used to characterize the response of unirradiated U–2 wt.% Zr alloy to heat treatment and the effects of irradiation on the alloy. A variety of matrix grain sizes and second-phase distributions were produced by heat treatment before irradiation. Irradiation of an alpha + delta structure caused the formation of gas bubbles and the partial dissolution of the delta phase. (auth)

28032 (EOS-1592-2M-1) HIGH TEMPERATURE SEMICONDUCTING COMPOUNDS FOR THERMOELECTRIC POWER GENERATION. Bi-Monthly Progress Report No. 1, December 15, 1960 to February 15, 1961. C. Leung (Electro-Optical Systems, Inc., Pasadena, Calif.). Feb. 15, 1961. Contract NObs-84327. 6p.

The initial report in a project to find high-temperature semiconducting compounds for thermoelectric power generation is presented. Systems to be studied include combinations of uranium and/or thorium with sulfur, selenium and/or tellurium. A short literature survey is included and properties of compounds of the elements to be studied are summarized tabularly. (J.R.D.)

28033 (GA-2379) DISLOCATION RELAXATION SPECTRA IN PLASTICALLY DEFORMED REFRACTORY BCC METALS. R. H. Chambers and J. Schultz (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Aug. 8, 1961. Contract AT(04-3)-167. 40p.

This paper was presented at the Conference on Internal Friction due to Crystal Lattice Imperfections held at Cornell Univ., Ithaca, N. Y., on July 10-12, 1961.

Pairs of broad, thermally activated stress-relaxation peaks were produced by room-temperature plastic deformation of the bcc transition metals Nb, Ta, and Mo. At least one peak and perhaps two existed in hot-worked tungsten. The effective activation energies of these peaks were measured by internal-friction methods at frequencies from 5 to 100,000 cps at strain amplitudes near 10^{-7}. These mechanical-relaxation phenomena were interpreted in terms of some kind of thermally activated motion of segments of dislocation lines over intrinsic lattice-potential barriers. Relatively low-temperature anneals produced a lowering of the peak heights as well as a decrease in the peak temperature. Measurements on cold-worked molybdenum and tantalum containing small amounts of interstitial

impurities showed evidence of a post-relaxation rise in the background internal friction similar to that found in lightly cold-worked copper single crystals. Increased amounts of impurities and/or heavy cold working sharply reduced this background contribution in tantalum. A thermal-aging treatment at temperatures just under the recrystallization temperature produced a large increase in the modulus as measured at room temperature but very little change as measured at 5°K. (auth)

28034 (HW-67737) OBSERVATIONS ON THE MICROSTRUCTURE OF PLUTONIUM. R. D. Nelson and H. R. Gardner (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1961. Contract AT(45-1)-1350. 16p.

Photomicrographs are presented illustrating the various configurations of the $Pu-Pu_6Fe$ eutectic, PuN, PuC, and Pu_xMg_y inclusions in both as-reduced and recast plutonium. Several variations in the microstructure were observed with respect to inclusion distribution, size, and shape. The variations, a result of heat treating and casting conditions, are illustrated. The average recast grain size was 0.040 mm. Preliminary investigation of the effect of the beta-alpha transformation rate on the alpha grain size showed that decreasing the isothermal quench temperature from 73 to −23°C after holding one hour at 175°C resulted in a decrease in grain size from 0.023 to 0.006 mm. Extensive microcracking was observed in plutonium having less than 500 ppm iron. The presence of 500 to 1500 ppm iron was found to inhibit microcracking. (auth)

28035 (IOI-210) SUMMARY OF THE FABRICATION AND BEHAVIOUR OF STANDARD URANIUM RODS IN THE NRX REACTOR 1947 TO 1960. G. C. Garrow (Atomic Energy of Canada Ltd., Chalk River, Ont.). Feb. 1961. 27p. (AECL-1298)

The available average data on the source of metal, rolling conditions, heat treatment, analysis, irradiation received, length change on irradiation, reason for removal, and condition on removal are presented in tabular form for ease of reference for all batches of standard NRX rods irradiated from the beginning of operation in 1947 until the end of 1960. (auth)

28036 (LAMS-2496) METALLURGICAL EVALUATION OF TANTALUM ALLOYS. PART I. TANTALUM CONTAINING 0.1 OR 3.0/w/o TUNGSTEN. R. W. Keil, G. S. Hanks, and R. I. Batista (Los Alamos Scientific Lab., N. Mex.). Dec. 1, 1960. Contract W-7405-Eng-36. 51p.

The fabrication of Ta−0.1 wt % and Ta−3.0 wt % arc-cast billets into 0.020-in. thick sheets is reported. The results of feasibility studies of the sheets with respect to recrystallization, mechanical properties, cup tests, deep drawing, resistance seam welding, and channel forming are presented. (D.L.C.)

28037 (NAA-SR-Memo-6512) URANIUM CARBIDE. A Bibliography. M. Bloomfield (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 13, 1961. 29p.

A bibliography is presented which includes data directly related to the use of uranium carbide as a nuclear fuel to June 1, 1961. The material was organized according to the following sections: general, bibliographies, irradiation effects, preparation, fabrication, structure and constitution, high-temperature properties, physical properties, metallography, diffusion studies, chemical properties, corrosion and compatibility, UC systems with alloy additions, UC dispersions, and progress reports. (347 references.) (auth)

28038 (NASA-TN-D-871) GAS FLOW, EMITTANCE, AND ION CURRENT CAPABILITIES OF POROUS TUNGSTEN. Thaine W. Reynolds and Lawrence W. Kreps (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1961. 43p.

Analysis of cesium ion current and propellant utilization capabilities of porous tungsten, based on a simple model of a porous structure, indicated that pore sizes of 1 micron and less would be desirable. Gas flow measurements indicated that some difficulty might be experienced in operating smaller particle size porous tungsten structures at the required surface temperature for high current density because of the possible sintering of the tungsten. Experimental gas flow measurements through porous tungsten disks made from 1-, 10-, and 20-micron powder are presented. Sintering temperatures above 1500°K affected the permeability of the 1-micron-pore material. This temperature range is a desired operating range of the cesium-tungsten system for ion rocket applications. Emissivity measurements on these same materials yielded an average spectral emittance of about 0.8 at a wavelength of 0.65 micron. Total radiation measurements gave emittance values in the range of 0.31 to 0.68. (auth)

28039 (NEPA-1516) TENSILE AND CREEP PROPERTIES OF GRAPHITE FOR NEPA PROJECT. R. E. Adams and H. R. Nelson (Battelle Memorial Inst., Columbus, Ohio). May 1, 1950. Decl. May 20, 1959. 56p.

An investigation was undertaken to determine tensile strength and creep in graphite as a function of temperature. Tensile and creep tests were made on type C-18 and AGHT graphite at temperatures up to 5100°F. Tensile strength was observed to increase with temperature, and creep does not appear to be a serious problem in graphite for structures subject to 2500°F temperatures. (J.R.D.)

28040 (NP-10360) RELACIÓN ENTRE LAS SUBESTRUCTURAS DE SEGREGACIÓN Y LAS DISLOCACIONES FORMADAS DURANTE LA SOLIDIFICACION, EN ALUMINIO 99,99 o/o. Informe No. 46. (Relation Between the Segregation Substructures and Dislocations Formed During the Solidification of Aluminum. Report No. 46). Heraldo Biloni (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). 1960. 13p.

In polycrystals from the fusion of 99.99% Al, in which the solidification had been interrupted, the cellular or de Smialowski substructure was studied beginning with the interface. The persistence in the detection of substructures by means of thin epitaxic lamina was determined by crystalline orientation. By the same technique, the existence of a macrosegregation substructure, derived from the size of the original grain, was determined. The utilization of the method of corrosion figures in conjunction with the thin epitaxic lamina permits the detection of dislocation associations and their relationship with segregated areas, such as the appearance of the macromosaic substructure lying close to the cellular substructure. The results are interpreted with the theories of solute microsegregations. (tr-auth)

28041 (NP-10475) ENGINEERING PROPERTIES OF POTASSIUM. Third Quarterly Report, April 1 Through June 30, 1961. Alexis W. Lemmon, Jr. (Battelle Memorial Inst., Columbus, Ohio). Aug. 3, 1961. Contract NAS 5-584. 27p.

Additional information on the compatibility of potassium with the Nb−1Zr alloy was obtained. Exposure of two test strips in a sealed capsule containing potassium at 2100 F for 8 hours resulted in no attack of the capsule or test strips. The contamination of the potassium was insignifi-

ant. Fabrication of the steady-state longitudinal-heat-flow apparatus for determining the thermal conductivity of liquid potassium is in progress. Calibration and check-out of the oscillating-cylinder viscometer for measuring the viscosity of liquid potassium are proceeding. Damping appears uniform, with a maximum variation from the mean value of 0.013%. The design of the P-V-T apparatus was completed; fabrication and assembly are in progress. The apparatus is essentially a constant-volume bomb connected to a loading device and a pressure-sensing system through a small-bore capillary tube. Preliminary design of the apparatus to determine the specific heat of potassium vapor was achieved. A large molybdenum block will be used to assure constant temperature of the enclosed calorimeter. A constant flow rate of potassium vapor will be achieved by use of a constant-speed drive attached to a bellows through a screw. (auth)

28042 (NP-10526) DEVELOPMENT OF ULTRA REFRACTORY MATERIALS. Progress Report No. 25, May 1, 1961 through July 31, 1961. Peter T. B. Shaffer (Carborundum Co. Research and Development Div., Niagara Falls, N. Y.). Aug. 16, 1961. Contract NOrd-17175. 19p.

Melting and emissivity studies showed an apparent, reversible crystalline change in ZrC and TaC but not in TaC–ZrC solid solutions. (D.L.C.)

28043 (NP-10527) EXO-REACTANT NICKEL BASE STRUCTURAL ADHESIVES. Quarterly Progress Report No. 1, January 1–March 31, 1961. Ralph Armstrong and Roger A. Long (Narmco Industries Inc., San Diego, Calif.). Apr. 9, 1961. Contract NOw 61-0308-c. 12p.

A method was developed for bonding stainless steel by utilizing an exothermic reaction, the products of which provide the braze alloy, flux, and the major part of the heat required. Experiments are being conducted to improve exoadhesive compositions and to develop methods for applying the process to nickel-base super alloys. (auth)

28044 (NP-10562) A STUDY OF THE INFLUENCE OF HEAT TREATMENT ON MICROSTRUCTURE AND PROPERTIES OF REFRACTORY ALLOYS. Quarterly Report No. 3, September 1–November 30, 1960. W. H. Chang (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Nov. 30, 1960. Contract AF33(616)-7125. 73p. (DM-60-279)

The annealing and aging reactions in several of the selected refractory alloys were studied. The microstructural changes in Nb–1Zr after various heat treatments were correlated with the previously-reported hardness changes. "Anneal" hardening was due to dissolution of interstitial-compound phases, whereas age softening was found to be caused by grain-boundary precipitation. The room-temperature and 1800°F tensile properties of Nb–1Zr after appropriate heat treatments were determined. Pronounced serrated yielding, apparently associated with strain aging, was observed at 1800°F under, however, certain heat-treated conditions only. The high-temperature strain aging appeared to lend evidence to complex clustering of substitutional and interstitial solute atoms. A more detailed study of the temperature-time dependency of the solutioning and aging reactions in the Mo–TZC alloy was completed, resulting in a gratifying correlation among heat treatments, hardness, microstructure and phase identification. This study established beyond any doubt the process of precipitation hardening in the Mo-base alloy and showed conclusively that the hardening process was associated primarily with the extensive precipitation of titanium carbide. Evidence is presented, indicating that the solubility of carbon in Mo may be sensitively affected by Ti, possibly in conjunction with Zr. The response to heat treatments of the Mo–0.04C, Mo–0.5Ti–0.035C and Mo–TZ alloys was also investigated. None of these alloys exhibited hardening upon high-temperature annealing or subsequent aging. This lack of response was related either to low interstitial contents or to insufficient carbide solutioning even at every high temperatures. The grain growth characteristics of Mo and the Mo alloys were compared. This comparison showed that the high-temperature grain-boundary motion in Mo was effectively retarded by carbide dispersion but not at all by Ti and Zr in solution. (auth)

28045 (NP-10599) INVESTIGATION OF SINTERABLE POWDERS AND CERAMICS MADE FROM THEM. Second Quarterly Report. C. Hyde, A. Rudnick, M. J. Snyder, and W. H. Duckworth (Battelle Memorial Inst., Columbus, Ohio). Aug. 21, 1961. Contract AF 33(616)-7733. 23p.

Investigations were made of the effect of heating rates on calcining of $MgCO_3$ and sintering of the resultant MgO powder. Variations in the calcining process had no effect on the sinterability of the MgO powder, except in the case of very high calcining temperatures which resulted in less sinterability. Sinterability was found to be unaffected by moderate temperature differences during sintering, although control of the heating rate during sintering is important to prevent overcalcining or cracking. Results are reported for diametral-compression tests using loading platens. (D.L.C.)

28046 (NUMEC-P-34) DEVELOPMENT OF PLUTONIUM BEARING FUEL MATERIALS. Monthly Progress Letter for Month of August 1961. Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Penna.). Sept. 5, 1961. Contract AT(30-1)-2389. 5p.

Surface area measurements on UO_2–PuO_2 and PuO_2 powders are reported. Fabrication and evaluation of PuO_2 shapes are reported. Work on resonance integrals of UO_2 and U rods is described. (D.L.C.)

28047 (TID-13213) REPORT OF DRY RUNNING TWO 440C HEAT-TREATED STAINLESS STEEL ANNULAR BALL BEARINGS IN A HELIUM ATMOSPHERE. J. H. Rumbarger (Messinger Bearings, Inc., Philadelphia). Mar. 1961. For Kaiser Engineers, Div. of Henry J. Kaiser Co., Oakland, Calif. Contract AT(10-1)-925. 50p.

The heat-treated stainless steel bearings operated satisfactorily when revolved under light loading at low rpm without lubricant in a helium atmosphere. The ball weights and critical dimensions showed no change. The power requirements and the temperature readings of the bearings are given. (D.L.C.)

28048 (WADC-TR-59-441(Pt.II)) THE INVESTIGATION OF THE MECHANISM OF SUBSTRUCTURAL FORMATION IN REFRACTORY METALS AND THE RELATION TO THE OBSERVED MECHANICAL PROPERTIES. M. A. Adams and A. Iannucci (Materials Research Corp., Yonkers, N. Y.). Aug. 1960. 33p. Contract AF33(616)-5908.

An apparatus is described for preparing 9-in. long molybdenum crystals by floating-zone electron bombardment melting. Etch-pit techniques for revealing dislocations and sub-boundaries in molybdenum were investigated. Differences in etching characteristics of various methods investigated are discussed. Comparative creep tests were made at 1000°C on "as-grown" and polygonized beam-melted molybdenum crystals. (auth)

28049 (WADD-TR-61-134) RESEARCH ON WORKABLE REFRACTORY ALLOYS OF TUNGSTEN, TANTALUM, MOLYBDENUM, AND COLUMBIUM. (Crucible Steel Co. of America, Pittsburgh). Apr. 1961. Contract AF33(616)-6172. 73p.

Tungsten- and tantalum-rich alloys of the W–Ta–Mo–Nb system were studied for high-strength structural applications above 2500°F. Twenty specific compositions, including binary, ternary, and quaternary alloys were investigated. Several homogeneous and contamination-free ingots of each alloy were melted by use of a specially designed comsumable-electrode vacuum-arc melting unit. Special techniques were developed for the impact extrusion of the alloys, and all alloys were successfully extruded at 2500 to 4000°F. Creep and tension tests were conducted on the as-extruded samples at 3000°F in vacuum. The high-temperature strength of the tungsten-rich alloys was increased considerably by the addition of columbium, and the high-temperature strength of the tantalum-rich alloys was appreciably increased by additions of molybdenum and tungsten. One alloy (88.6 W–5.7 Mo–5.7 Nb) had a tensile strength of 62,000 psi at 3000°F; several other alloys had tensile strengths in excess of 50,000 psi. The strengths were attained by a combination of solid-solution strengthening and strain hardening. On the basis of results of the investigation, the tungsten- and tantalum-rich alloys of the W–Ta–Mo–Nb system offer excellent promise as wrought materials for structural applications at very high temperatures. (auth)

28050 (AEC-tr-4380) PROPERTIES OF COLD DRAWN URANIUM RODS. I. ON THE THERMAL EXPANSION COEFFICIENTS AND THE THERMAL CYCLING GROWTHS OF RECRYSTALLIZED RODS. Ko Soeno. Translated from J. At. Energy Soc. Japan, 2: 89-95(1960). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 12965.

28051 (AEC-tr-4771) FRENCH NUCLEAR GRAPHITE. Translated for Oak Ridge National Lab. from Bull. inform. sci. et tech. (Paris), No. 48, 2-60(Feb. 1961). 91p.

The development of nuclear graphite in France is discussed. The essential raw materials for the production of graphite are petroleum coke and coal tar. The production method is described. The uses of testing stations, a semi-industrial plant, and a laboratory are discussed. The physical properties of nuclear graphites are outlined and the changes in these properties after irradiation are discussed. The influence of chemical purity on the nuclear properties of graphite was determined. The interactions of heat-transfer gases with graphite were studied. Irradiations in pile and loop experiments are described. (M.C.G.)

28052 (CEA-tr-A-937) LA DIFFUSION DANS L'OXYDE D'URANIUM DU XENON-133 PROVENANT DE LA FISSION. (Diffusion in Uranium Oxide of Xe-133 Produced by Fission). F. Felix. Translated into French from Nukleonik, 66-7 (1958). 6p.

The diffusion of fission-produced Xe^{133} in foils, powders, and tablets of hydrated UO_2 was studied. Each sample was exposed to reactor radiation for one day, and measurements were made five days later. The diffusion of Xe released by the UO_2 does not have a simple form. The quantity of Xe increases, for a given temperature, to a saturation value. An increase of temperature causes a rise in the saturation value. It was observed that the Xe activity in the gaseous phase, at a given temperature, increases only to a given degree. The form of the UO_2 samples has no clear effect on the Xe release. (J.S.R.)

28053 A NEUTRON-DIFFRACTION STUDY OF VERY PURE CHROMIUM. G. E. Bacon (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Acta Cryst., 14: 823-9(Aug. 10, 1961).

Single crystal and polycrystalline samples of pure chromium (0.01% oxygen, 0.001% nitrogen, 0.0002% metallic impurities by weight) lose the major portion of their antiferromagnetic ordering at 40°C, but there remains some residual order in polycrystalline material and this increases with reduction of grain size. In all cases it is concluded that the magnetic moment on the chromium atom, well below the Néel temperature, is about $0.45\mu_B$. With addition of 0.5% of iron and 0.16% of nickel the Néel temperature is lowered to 26°C. (auth)

28054 GRAIN BOUNDARY ADSORPTION AND "SUPERHIGH PLASTICITY." Michael G. Lozinskiĭ (Lozinsky) (Inst. of Machine Engineering, Academy of Sciences, USSR). Acta Met., 9: 689-94(July 1961). (In English)

New experimental data on the influence of adsorption of impurities by grain boundaries in iron, titanium, and zirconium on the development of "superhigh plasticity" under cyclic fluctuations of temperature are described. The factors are explained which result in formation of two necks in the specimens undergoing tension and heating. The tentative evaluation of carbon concentration in the grain boundary of technical iron is given. Further investigations on the factors leading to "superhigh plasticity" in metals and alloys and experimental determination of "danger" temperature intervals, within which rapid loss of strength takes place, are necessary as these are of theoretical interest and may be important for practical application. (auth)

28055 MAGNETIC PROPERTIES OF URANIUM–SELENIUM ALLOYS. W. Trzebiatowski and W. Suski (Inst. of Physical Chemistry, Polish Academy of Sciences, Wroclaw and Technical Univ., Wroclaw, Poland). Bull. acad. polon. sci., Ser. sci. chim., 9: 277-81(1961).

The phase composition and some representative values of the magnetic susceptibilities are given for the proposed compounds: USe_3, USe_2, U_3Se_5, U_2Se_3, and USe. It was found that the susceptibilities of samples with higher selenium content, USe_3, USe_2, $USe_{1.77}$, and U_3Se_5, follow the Curie–Weiss law. (P.C.H.)

28056 THE BEHAVIOR OF FISSION PRODUCTS CAPTURED IN GRAPHITE POWDER BY NUCLEAR RECOIL. IV. FURTHER STUDIES ON THE DIFFUSION OF XENON-133 IN GRAPHITE. Seishi Yajima, Sumio Ichiba, Yuichiro Kamemoto, Koreyuki Shiba, and Masaharu Kori (Japan Atomic Energy Research Inst., Tokyo and Mitsubishi Atomic Power Industries Inc. Lab., Saitama, [Japan]). Bull. Chem. Soc. Japan, 34: 697-701(May 1961). (In English)

Experiments were carried out on artificial graphite and natural graphite-1 and graphite-2. The experiment on natural graphite-2 showed no striking effect of the rate of temperature increase; the amount (46.3%) of Xe-133 released when the temperature of a graphite sample was increased from room temperature to 800°C in 3 min and kept constant at 800°C for 90 min was nearly equal to the amount (41.7%) of Xe-133 released when the temperature of another sample was increased from room temperature to 800°C at a rate of 3°C/min. Therefore the amount of Xe-133 released is mainly determined by a final temperature. The activation energy of diffusion in artificial graphite was found to be a little higher than that in natural graphite. Heating curves are given to show the distribution of the amount of released Xe over a wide range of temperature. (P.C.H.)

28057 SELF-DIFFUSION IN BODY-CENTERED CUBIC ZIRCONIUM. G. Kidson and J. McGurn (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1146-57(Aug. 1961). (AECL-1271)

Self-diffusion coefficients of crystal-bar zirconium were measured between 1500°C and 1100°C, using radioactive

Zr^{95} as a tracer. The results may be represented by $D = 2.4 \times 10^{-4} \exp -[30{,}100/RT]$ cm^2/sec. The pre-exponential factor is about three orders of magnitude smaller than that measured in most close-packed systems and the activation energy about one-half that anticipated from an empirical correlation with the melting point. The results, however, are similar to those of a few other recently studied body-centered cubic (BCC) systems, and agree quantitatively with work in the Soviet Union on zirconium. There is considerable evidence that the diffusion process occurs via vacant lattice sites. (auth)

28058 AN INVESTIGATION OF THE ELECTRICAL RESISTANCE OF CERIUM, LANTHANUM AND NEODYMIUM AT PRESSURES UP TO 250,000 KG/CM^2. L. F. Vereshchagin, A. A. Semerchan, and S. V. Popova (Inst. of High Pressure Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 1059-61(June 11, 1961). (In Russian)

It was found that cerium has a minimum electrical resistance at 55,000 kg/cm^2 which increases to a maximum at 80,000 kg/cm^2. This maximum indicates a polymorphic transformation at this pressure. Chemically pure lanthanum (0.3% Nd, 0.2% Pr and 0.02% Fe) showed a minimum in electrical resistance at 95,000 atm. with a slight increase to a maximum at 110,000 atm. Then, the electrical resistance again increases to a maximum at a pressure of 140,000 kg/cm^2 and continues to decrease thereafter up to pressures of 250,000 kg/cm^2. A sample of lanthanum containing greater amounts of impurities (0.75% Nd, 0.70% Pr and 0.04% Fe) showed only a continuous decrease in electrical resistance with pressure. It can be assumed that La like Ce undergoes a polymorphic transformation, but at a somewhat higher pressure (110,000 kg/cm^2). Neodymium showed a minimum in the electrical resistance at 80,000 kg/cm^2 and a maximum at 90,000 kg/cm^2. The disagreement with the data of Bridgeman may be due to the difference in chemical purity of the samples investigated. All measurements were carried out at room temperature on metallic wire samples 1 to 1.5 mm in diameter. (TTT)

28059 THERMOELECTRIC CHARACTERISTICS OF HIGH-TEMPERATURE THERMOCOUPLES WITH REFRACTORY ELECTRODES. P. S. Kislyi, V. I. Lakh, G. V. Samsonov, B. I. Stadnyk, R. F. Kharenko, and A. B. Chekhovich. Izmeritel'naya Tekh., No. 5, 21-3(May 1961). (In Russian)

Two concentric tubes made of refractory materials are used in making a thermocouple. The external carbide, boride, nitride or silicide serves as a protective jacket and thermoelectrode simultaneously. These refractory thermocouples have a high thermal emf and a high temperature sensitivity amounting to 75 $\mu V/^0C$. Thus, the TiC-C (2500°C) and ZrB_2-C (2000°C) thermocouples have similar characteristics, while a $MoSi_2$-WSi_2 (1650°C) thermocouple has thermoelectric characteristics similar to platinum or platinum-rhodium thermocouples (the temperatures in parenthesis give the upper measurement limits). The TiC-C thermocouple is used in vacuum or reducing atmospheres, the ZrB_2-C thermocouple in oxidizing atmospheres. The TiC-C couple operated greater than 200 hours at 2400°C without failure; the ZrB_2-C couple was immersed several hours in molten steel at 1700°C without visible sign of failure, and it is estimated that the disilicide thermocouple would last more than 100 hours in an oxidizing atmosphere. Baking at high temperatures stabilizes the behavior of the refractory thermocouples. (TTT)

28060 STORED ENERGY IN FUEL-BEARING GRAPHITE. A. H. Willis, J. M. Baugnet, and R. C. De Beukelaer (Centre d'Etude de l'Energie Nucleaire, Mol. Belg.). J. Appl. Phys., 32: 1622-3(Aug. 1961).

Fission product damage to graphite, particularly with regard to Wigner energy storage, was studied. A sample of Pechiney graphite was impregnated by U^{235} in the form of UO_2. The stored energy was measured and found to be many times that from neutron bombardment alone. The stored energy in neutron-bombarded material has been attributed to the trapping of carbon atoms displaced from their normal lattice positions. (L.N.N.)

28061 THE THERMAL AND ELECTRICAL CONDUCTIVITIES OF ZIRCONIUM AND OF SOME ZIRCONIUM ALLOYS. R. W. Powell and R. P. Tye (National Physical Lab., Teddington, Middx., Eng.). J. Less-Common Metals, 3: 202-15(June 1961). (In English)

Three samples of zirconium and nine zirconium alloys were studied, six with tin contents ranging from 0.84–6.7 wt.%, and alloys with 1.48% aluminum, 7.6% molybdenum, and 9.79% niobium. The thermal conductivity of zirconium was measured to 780°C and the electrical resistivity to 970°C. The Lorenz function is found to decrease from about $3.10 \cdot 10^{-8}$ to $2.63 \cdot 10^{-8}$ J ohm/sec °C °Abs. over the range 50–750°C. For these alloys the thermal conductivity determinations were mainly restricted to the range 50–250°C, and the electrical resistivity determinations mainly covered the range 20–600°C. Higher temperatures were reached in a few cases and the molybdenum and niobium alloys were found to undergo considerable changes in both properties after heat treatment, presumably due to the occurrence of phase changes when held at temperatures above 400°C. In two instances, for a 1.65% tin alloy and the heat-treated niobium alloy the thermal conductivity determinations were extended to over 600°C. Using the values at 50, 150, and 250°C the line $K = 2.503 \cdot 10^{-8}\ T/\rho + 0.0223$ is obtained from a plot of thermal conductivity, K, expressed in J cm/cm^2 sec °C, against absolute temperature, T, divided by electrical resistivity, ρ, ohm cm^2/cm. All points are within 11% of this line and all but three within 5%. Results of other workers are discussed and examined in a similar way. (auth)

28062 HARDENING OF A MOLYBDENUM–ZIRCONIUM ALLOY BY NITRIDE DISPERSIONS. A. K. Mukherjee and J. W. Martin (Oxford Univ.). J. Less-Common Metals, 3: 216-20(June 1961). (In English)

A 1% Zr–Mo alloy was nitrided in the temperature range 1100–1500°C, producing a highly stable dispersion of ZrN in Mo. The effects of employing an atmosphere of nitrogen and of ammonia during the isothermal heat treatment were compared. The dispersed phases were studied metallographically, and microhardness traverses made of the diffusion layers. The results are discussed in terms of the relationship between hardness, particle sizes, and diffusion rates. (auth)

28063 FERROMAGNETISM OF THE INTERMETALLIC COMPOUND UFe_2. Shigehiro Komura, Nobuhiko Kunitomi, Yoshikazu Hamaguchi, and Masanobu Sakamoto (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Japan, 16: 1486(July 1961). (In English)

The magnetic properties of UFe_2 were investigated at 300°K to 100°K. Metallic uranium and electrolytic iron, each 99.9% pure, were melted together in a vacuum and held at 1300°C for one hour, after which they were cooled to room temperature. Further cooling revealed evidence of ferromagnetism at 195°K. (L.N.N.)

28064 THE REASONS OF THE NON-HOMOGENEITY IN THE CONCENTRATION OF SOLID SOLUTIONS. K. K. Kasymbekova and A. A. Presnyakov (Inst. of Nuclear Phys-

ics of the Kazakh SSR). Metalloved. i Termicheskaya Obrabotka Metal., No. 7, 20-2(July 1961). (In Russian)

The lack of uniformity in the concentration distribution of solid solutions is attributed to intracrystalline adsorption which results in the enrichment of certain elements at the grain boundary. This uneven distribution of the components is changed by diffusion processes which exert a considerable influence on the properties of the alloy. As a general rule, the non-homogeneous pattern is noted in alloys which present a continuous series of solid solutions without being able to form a secondary phase in the interdendritic areas. The magnitude of the non-homogeneous concentration distribution depends on the composition of the alloy, being larger for high-alloy materials and increasing if elevated annealing temperatures are used. Upon melting, the composition of the first drops of liquid metal differs greatly from the average composition of the system. These third-type non-homogeneities cause phase transformations in regions far removed from the equilibrium lines of the phase diagram. The diffusion process takes place before the reorganization of the lattice at temperatures and concentration ranges at which phase transformations occur. (TTT)

28065 THE STRENGTH OF STEEL AND PERTINENT ALLOYING PROBLEMS. A. P. Gulyaev (Central Scientific Research Inst. of Ferrous Metallurgy, USSR). Metalloved. i Termicheskaya Obrabotka Metal., No. 7, 23-8(July 1961). (In Russian)

The widespread use of steel as a construction material is due to the favorable combination of mechanical properties; in the form of wires, its strength may exceed 500 kg/mm^2. These properties are not due to a single optimum addition but to the basic structure of the alloy. Hardenability is ensured by the introduction of the usual (Cr, Mn, Ni, and Mo) and of specially-acting (B, Zr and rare earth elements) components which do not permit formation of high-alloy systems. The inherent fine-grain structure is obtained by deoxidation by means of Al + Ti additions, carefully limiting the residual concentration of these elements. Supplementary micro-alloying is carried out by adding V, Nb, or Ti. Introduction of 1 to 3% Ni results in a further increase of ductility. Embrittlement during tempering may be inhibited by alloying the steel with 0.2 to 0.4% Mo; in view of the strong effect of this metal on the hardenability of the steel, a further increase of its concentration is not necessary. (TTT)

28066 ALLOYS OF THE Ti–Al–Mn SYSTEM. L. P. Luzhnikov and V. N. Moiseev. Metalloved. i Termicheskaya Obrabotka Metal., No. 7, 29-34(July 1961). (In Russian)

The mechanical and engineering properties of the Ti–Al–Mn system up to a Mn and Al concentration of 9% for each of these additives were investigated for the purpose of developing compositions suitable for the fabrication of sheets. The specimens prepared were soaked at 800°C for 1 hour in vacuum, then cooled at a rate of 2 to 3°C/min. Several melts presented a good combination of plasticity and tensile strength at room temperature: the yield strength of the high-alloy material reached a value of 115 kg/mm^2, its elongation was 12% and its toughness 3.3 kgm/cm^2; the yield strength increase and the two other properties decreased with respect to technical Ti. Tensile tests at room temperature showed that addition of Al and Mn exerts a beneficial effect. Increase of the Al concentration reduced the forgeability of the alloy; Mn affected the weldability unfavorably. Commercial alloys of this system were also tested and were found to have properties similar to technical Ti. The technical alloys could be easily welded under argon arc. The annealing temperature had a noticeable influence on the mechanical properties of the alloys; with increasing Al concentration the annealing temperature must be raised. (TTT)

28067 THE EFFECT OF SMALL ADDITIONS OF TITANIUM, BERYLLIUM, GALLIUM, RHENIUM AND NIOBIUM ON THE GRAIN SIZE OF ALUMINUM AFTER ANNEALING AND DEFORMATION. A. P. Belyaev and R. M. Gol'shtein. Metalloved. i Termicheskaya Obrabotka Metal., No. 7, 37-8 (July 1961). (In Russian)

Various elements in amounts of fractions of 1% were introduced into Al (already containing 0.14% Fe, 0.11% Si and 0.0035% Cu) for the purpose of reducing the grain size of the sheet metal. The ingots were laminated on a laboratory rolling mill at 420°C from 17 to 4 mm, then annealed at 350°C and cold-rolled to a thickness of 1 mm. The tensile test specimens were annealed again at 350°C for 1 hour, then were subjected to deformation testing. The recrystallized original metal presented a coarse-grained structure after 7 to 15% deformation. Addition of 0.2% Ti prevented the appearance of the coarse-grained structure even after 15% deformation. Similar additions of 0.05 to 0.5% Be, 0.05 to 0.2% Nb or 0.1 to 0.5% Ga did not affect the grain size after deformation. The metal containing 0.2% Re presented a coarse-grained structure only after a 15% deformation; lower concentrations of this element did not have a positive effect on the graininess. (TTT)

28068 THE EFFECT OF ADDITIONAL ANNEALING ON THE PROPERTIES OF METAL-CERAMIC SINTERED CARBIDES OF WC–Co. I. N. Chaporova, E. S. Shchetilina, and O. I. Serebrova (All-Union Scientific Research Inst. of Sintered Carbides, [USSR]). Metalloved. i Termicheskaya Obrabotka Metal., No. 7, 44-6(July 1961). (In Russian)

The solubility of WC in Co in the solid state in the pseudo-binary WC–Co system is dependent on the temperature. It was attemped to establish the effect of this behavior on the mechanical properties of several technical metal-ceramic specimens by annealing the WC–Co samples at 750, 500, 250, and 150°C in a resistance furnace, cooling them after the temperature was held constant at a rate of 2°C/min. The graphite contained in the system facilitated the decomposition of the Co solid solution; the composition of the binder approached that of pure Co. Determination of the physical properties of the specimens after annealing showed that the heat treatment has hardly any noticeable effect. (TTT)

28069 THE EFFECT OF DIFFUSION-INDUCED POROSITY IN NICHROME ALLOY ON THE SINTERING OF NICKEL AND CHROMIUM POWDERS. S. M. Astrakhantsev, S. P. Gromova, V. L. Kalikhman, and Ya. S. Umanskii (Moscow Inst. of Steel). Metalloved. i Termicheskaya Obrabotka Metal., No. 7, 52-4(July 1961). (In Russian)

Mixtures of Cr and Ni powders were cold-pressed and the compacts with porosities of 10 to 15, 25 to 30, and 40 to 45% were sintered in a hydrogen stream for 8 hours. Study of the X-ray diffraction pictures showed a sudden change of the lattice constants and a loss of sharpness of the lines. This behavior is attributed to the change of the previously uniform character of the system: submicroscopic pores are formed in the solid solutions, reaching diameters of several hundreds of Angstrom units. The lack of uniformity is caused by closure of these pores, resulting in an interference with the diffusion of Cr the partial diffusion coefficient of which is considerably higher than that of nickel in the nichrome system. This heterogeneous nature of the sintered specimens is responsible for the lack of sharpness of the diffraction lines. After the Cr concen-

ration becomes more even, the number of vacancies increases until a certain amount of Cr is removed from the system. (TTT)

28070 STRUCTURAL CHANGES OF THE LAVES PHASES IN $ZrAl_2$ AND UAl_2 BY URANIUM OR ZIRCONIUM ADDITION. Siegfried Steeb and Günter Petzow (Max-Planck-Institut für Metallforschung, Stuttgart). Naturwissenschaften, 48: 450-1(1961). (In German)

According to structural observations on Al–U–Zr alloys, a quasibinary layer (Laves phase) exists between $ZrAl_2$ in the Al–Zr system and UAl_2 in the Al–U system. Guinier exposures with monochromatic CuK_α radiation of cast alloys in the quasibinary layer show that the UAl_2 lattice is maintained with high Zr additions. A pronounced solubility of U in $ZrAl_2$ could be assumed since the lattice constants of $ZrAl_2$ undergo no noticeable change after U addition. Precision determinations of the lattice constants were carried out on heat-treated alloys of quasibinary layers in order to test and refine the results from Guinier diagrams. The lattice constant for pure UAl_2 was measured as 7.7475 kX. Zr additions up to 22 at.% Zr cause an almost linear decrease of the UAl_2 lattice constants. The lattice constants of $ZrAl_2$ proceed parallel to the concentration axis for U additions up to 10% U. The number of atoms in the elementary cell was determined. The mechanism of the contraction of the UAl_2 lattice from Zr addition was described. (J.S.R.)

28071 LATTICE DYNAMICS OF ALPHA URANIUM. D. O. Van Ostenberg (Argonne National Lab., Ill.). Phys. Rev., 123: 1157-62(Aug. 15, 1961). (ANL-FGF-217).

The method developed by Begbie and Born has been applied to alpha uranium, where equations are developed which give the macroscopic elastic constants in terms of the microscopic force constants. Interactions of an atom with its first through fourth nearest neighbors, which involve twelve atoms, are considered. Through symmetry considerations, nineteen atomic force constants enter into this force system. An independent determination of the force constants is required before a valid verification of the solutions can be made. However, using measured values of the nine elastic constants, two sets of force constants are evaluated, one based upon quasi-central forces and the other upon neglect of fourth nearest neighbors. (auth)

28072 UNPAIRED SPIN DENSITY IN ORDERED Fe_3Al. S. J. Pickart and R. Nathans (U. S. Naval Ordnance Lab., Silver Spring, Md. and Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 123: 1163-71(Aug. 15, 1961). (BNL-5270)

A precise determination of the magnetic form factor of the ordered alloy Fe_3Al has been made by diffraction of polarized neutrons from a single crystal. Some 43 reflections in the angular range $\sin\theta/\lambda \leq 0.9$ A^{-1} have been examined and show characteristic departures from a smooth single-valued function, indicating that the unpaired electron density in the unit cell is not spherically symmetric. The data are analyzed in two ways: by comparison with form factors calculated from free-atom Hartree-Fock wave functions including crystal-field splitting effects, and by two-dimensional Fourier projections of the unpaired spin density. The analysis indicates that, while the two types of iron atom in the lattice have similar radial spin densities, their orbital symmetry is different. The results are discussed with reference to various theories of the electronic structure in transition metals. (auth)

28073 LOW-TEMPERATURE DISSIPATION PEAK IN NIOBIUM. P. G. Bordoni, M. Nuovo, and L. Verdini (Instituto Nazionale di Ultracustica, Rome). Phys. Rev., 123: 1204-6(Aug. 15, 1961).

The energy dissipation coefficient Q^{-1} and the resonant frequency of a circular plate of niobium have been measured as a function of temperature in the range 60-300°K. The measurements have been carried out at four different frequencies from 18 kc sec^{-1} to 174 kc sec^{-1} with strain amplitudes smaller than 10^{-7}. For each vibration mode a pronounced peak is found for the dissipation coefficient while the frequency-temperature curves show a corresponding inflection. The temperature T_m of the dissipation peak depends on the vibration frequency according to an Arrhenius equation which characterizes the thermally activated relaxation effects. The activation energy $\bar{W}$ and the limiting relaxation time $\bar{\tau}_0$ of the process have been computed and these values [$\bar{W} = 0.265$ ev and $(\bar{\tau}_0)^{-1} = 61 \times 10^{11}$ sec^{-1}] are in agreement with the values previously found in some fcc metals for the relaxation effect due to the motion of dislocations. The value of $\bar{W}$ found in niobium shows that the effect cannot be directly produced by the motion of interstitial atoms of hydrogen. (auth)

28074 FLUORESCENCE AND SCINTILLATION SPECTRA OF CsI (Tl) CRYSTAL. R. G. Lagu and B. V. Thosar (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sec. A, 53: 219-26(May 1961). (In English)

The fluorescence and scintillation spectra of Tl-activated alkali halide crystals are compared, using 1.3 Mev γ rays from Co^{60} and ultraviolet radiation in the range 2300 to 4400A. It is found that the fluorescence and scintillation centers are identical. The crystals studied are Tl-activated CsI, CsBr, KI, and NaI. (T.F.H.)

28075 CRYSTAL STRUCTURES OF HAFNIUM–BERYLLIUM COMPOUNDS. P. I. Kripyakevich, M. A. Tylkina, and E. M. Savitskii (L'vov State Univ., USSR and Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Soviet Phys.-Cryst., 6: 94(July-Aug. 1961).

Beryllium-hafnium alloys of various composition were formed by melting in an argon atmosphere in a high-frequency furnace or in an electric-arc furnace and studied by x-ray structural analysis and microstructure. For some of the alloys, the melting point, hardness, and microhardness were determined. The investigation showed that the alloys in the crystal-chemical respect resembles the beryllium-zirconium alloys. The compounds found to exist were $HfBe_2$, $HfBe_5$, Hf_2Be_{17}, and $HfBe_{13}$. The crystal structure and microhardness are given for each. (N.W.R.)

28076 CRYSTAL STRUCTURE OF COMPOUNDS IN THE Nd–Al, Y–Al, AND Gd–Fe SYSTEMS. P. I. Kripyakevich and E. I. Gladyshevskii (L'vov State Univ., USSR). Soviet Phys.-Cryst., 6: 95(July-Aug. 1961).

The crystal structure of $NdAl_2$, $NdAl_4$, YAl_4, and Gd_2Fe_{17} were determined and found to exist in their respective alloy systems. The systems were determined by x-ray analysis. The crystal parameters are given. (N.W.R.)

28077 X RAY DIFFRACTION ANALYSIS OF HIGH-TEMPERATURE SOLID SOLUTIONS OF Cr–W–Mo ALLOYS. N. V. Grum-Grzhimailo and D. I. Prokof'ev. Zhur. Neorg. Khim., 6: 1155-64(May 1961). (In Russian)

An x-ray-diffraction analysis was made of Cr–W–Mo alloy in order to determine the influence of the components on the solid solution lattice. (R.V.J.)

28078 CONSTITUTION DIAGRAM OF ALUMINUM-RICH Al–Zn–Mg–Cu ALLOY. A. M. Zakharov, I. N. Fridlyander, and N. M. Edel'man. Zhur. Neorg. Khim., 6: 1165-71(May 1961). (In Russian)

Isotherms were constructed for Al–Zn–Mg–Cu alloys at 460°C, and phase structures were studied at 430 and 200°C. The results of a microscopic analysis are discussed. (R.V.J.)

28079 POLYMORPHOUS TRANSFORMATIONS OF CHROMIUM AND CONSTITUTION DIAGRAM OF CHROMIUM RICH Cr–Ni ALLOYS. A. T. Grigor'ev, E. M. Sokolovskaya, N. A. Nedumov, M. V. Maksimova, I. G. Sokolova, and Yü-p'u Yeh. Zhur. Neorg. Khim., 6: 1248-51(May 1961). (In Russian)

Thermal, microscopic, and x-ray-diffraction analyses were made of chromium-rich Cr–Ni alloy, and the constitution diagram constructed on the basis of the obtained data shows the presence of four two-phase regions $\alpha + \beta$, $\beta + \gamma$, $\gamma + \delta$, $\delta + \epsilon$. Three eutectoid transformations appear at 850, 960, and 1140°C. The existence of eutectoid transformation was confirmed at 1220°C and 32% Ni. The results also confirm the presence of five chromium modifications. (R.V.J.)

28080 CONSTITUTION DIAGRAM OF Cr–Y ALLOYS. V. F. Terekhova, I. A. Markova, and E. M. Savitskii. Zhur. Neorg. Khim., 6: 1252-3(May 1961). (In Russian)

A constitution diagram was constructed for chromium (99.5% pure) and yttrium (97% metallic Y), and their physical and chemical reactions were analyzed. Microstructure analysis (at 1100°C for 150 hr) showed that with 0.4 wt% Y the alloys have two phases. Non-mixability of solid and liquid Cr and Y was observed at 15 to 70 wt% Y at 1760 ± 25°C. At 1315 ± 7°C, Y and Cr form eutectics containing ~13 wt% Cr. Microphotography of annealed specimens indicates Y solubility in solid Cr at 1100°C is near 0.5 wt% and at 1700°C near 1 wt%. It is also shown that additions of Y up to 2 wt% improves the corrosion resistance of chromium at temperatures up to 1200°C and increases plasticity. (R.V.J.)

28081 CONSTITUTION DIAGRAM OF TITANIUM–SCANDIUM ALLOYS. E. M. Savitskii and G. S. Burkhanov. Zhur. Neorg. Khim., 6: 1253-5(May 1961). (In Russian)

The constitution diagram of Ti–Sc alloy, developed with 99.7% pure iodide Ti and 96% pure Sc, shows an unlimited mutual solubility in the liquid state. Eutectic crystallization takes place at 1440°C. Additions of Sc to Ti lower the melting point and slightly increase (up to 900°) the temperature of polymorphous titanium transformation. Similar to other rare earth metals, Sc acts as an α stabilizer in titanium. The solubility of Sc in α titanium at 700°C is ~2 wt%. Additions of Ti to Sc reduce the temperature of polymorphous transformation from 1450 to 1330°C. The Ti–Sc constitution diagram indicates that the components do not form continuous solid solution series. The difference in Ti–Sc electronegativity is ~35, which is not favorable to continuous solid solution formation. (R.V.J.)

28082 PREPARATION AND PROPERTIES OF HfC. G. V. Samsonov and V. N. Paderno (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukranian SSR). Zhur. Priklad. Khim., 34: 963-9(May 1961). (In Russian)

An analysis is made of the preparation of HfC in vacuum according to the reaction $HfO_2 + 3C = HfC + 2CO$, using 99.37% HfO in stoichiometric composition with anthracite black with 0.07% ash and heated at 1000 to 2000°C. Dense specimens are prepared by hot pressing hafnium carbide powder at 3000°C. The specific conductivity of the HfC is 51.5 $\mu\Omega \cdot$ cm; electromotive force in vapor with lead is 18 μv/C°, elasticity modulus 359000 kg/mm^2, coefficient of thermal expansion 6.06×10^{-6}/C°, emission coefficient as 800 to 1600° (with $\lambda = 0.655$ mμ) is 0.77. The data are compared with physical properties of TiC and ZrC crystals. (R.V.J.)

28083 APPLICATIONS OF P^{32} RADIOISOTOPES IN TRACING INTERLAYER CHANGES AND WEAR RESISTANCE OF PHOSPHATE COATINGS. V. S. Lapatukhin and Yu. M. Ovchinnikov. Zhur. Priklad. Khim., 34: 1002-7 (May 1961). (In Russian)

The wear resistance of phosphate coatings was investigated using P^{32}. It was found that inside the coating the phosphate consists of triple decomposed salts. The surface layers of coatings on zinc and iron also contain double decomposed phosphate. (R.V.J.)

28084 ALLOYS OF Bi, Ti, AND Fe. V. F. Funke, S. I. Yudkovskii, and G. V. Samsonov. Zhur. Priklad. Khim., 34: 1013-20(May 1961). (In Russian)

Technology of titanium boride extrusion and sintering into dense systems is described. The structure and properties of TiB_2–Fe and TiB_2–WC–Fe are analyzed. (R.V.J.)

28085 ON THE β AND ζ PHASES IN V–O SYSTEM. P. V. Gel'd, S. I. Alyamovskii, and I. I. Matveenko (Inst. of Chemistry, Ural Branch, Academy of Sciences, Sverdlovsk, USSR). Zhur. Strukt. Khim., 2: 301-7(May-June 1961). (In Russian)

The existence of β and ζ phases in the V–O system was not confirmed. The ζ phase, similar to the TiO structure, has a double defect and homogeneity region from $VO_{0.85}$ to $VO_{1.25}$. Vanadium trioxide has a narrow concentration stability range ($VO_{>1.44}$ to $VO_{<1.65}$) with very small lattice parameter variations. (tr-auth)

28086 RARE EARTH ALLOYS. A Critical Review of the Alloy Systems of the Rare Earth, Scandium and Yttrium Metals. Karl A. Gschneidner, Jr. Princeton, New Jersey, D. Van Nostrand Company, Inc., 1961. 459p. $12.75.

The phase diagrams, crystallographic and thermodynamic data, and physical and mechanical properties are given of rare earth, scandium, and yttrium alloy and metal systems. The information came from references which were available before April 1960. A list is given of 653 references in the appendix. (N.W.R.)

28087 RARE METALS HANDBOOK. Second Edition. Clifford A. Hampel, ed. New York, Reinhold Publishing Corporation and London, Chapman & Hall, Ltd., 1961. 727p.

Production methods from ores or other raw materials, chemical and physical properties, fabrication techniques, and present and potential uses of 55 rare metals are presented. Selected bibliographical references are also presented for each metal. (N.W.R.)

28088 REFRACTORY METALS AND ALLOYS. VOLUME 11. Proceedings of a Technical Conference Sponsored by the Refractory Metals Committee of the Institute of Metals Division, The Metallurgical Society, and Detroit Section, American Institute of Mining, Metallurgical, and Petroleum Engineers, Detroit, Michigan, May 25-26, 1960. M. Semchyshen and J. J. Harwood, eds. New York, Interscience Publishers, 1961. $22.00.

Twenty-two papers are presented on the current state of the science, technology, development, and applications of the refractive metals and alloys. The common aspects and the differences existing among the individual materials with respect to alloying behavior, flow and fracture phenomena, oxidation and surface reactivity, and strengthening mechanisms are discussed. Particular emphasis is placed on the role and influence of interstitial elements, impurities, solute elements, and structure. The metallurgical characteristics of the individual refractory metal systems are presented. As a group the materials are considered with respect to their fabrication, engineering behavior, and current and proposed fields of applications. (N.W.R.)

28089 PLUTONIUM–ZIRCONIUM ALLOYS. (to U. S. Atomic Energy Commission). British Patent 873,963. Aug. 2, 1961.

The preparation and properties of a reactor fuel alloy consisting essentially of from 5 to 50 atomic percent zirconium and the balance plutonium are described. The alloy has the face-centered cubic structure of delta-plutonium. The alloy has good neutronic, corrosion, fabrication, and dimensional characteristics through a wide temperature range. (N.W.R.)

Radiation Effects

28090 (60-GC-150) ELECTRON INDUCED RADIATION DAMAGE IN PURE METALS. Scientific Report No. 3. R. M. Walker (General Electric Co. Research Lab., Schenectady, N. Y.). Nov. 29, 1960. Contract AF19(604)-5557. 43p. (AFCRL-TN-60-1122; PB-171523)

The quantitative aspect of electron damage experiments was investigated. The material presented is divided into five main sections. The first section considers very briefly some of the general features of electron irradiation of solids. The second section briefly reviews work on the low-temperature electron bombardment of high-purity copper. It is shown that there is reasonable agreement between theory and experiment for both the production and recovery of damage at low temperatures. The third section discusses some recent work on the influence of lattice imperfections on the damage and recovery processes. New results in Al, Ag, Au, Ni, and Fe are presented in the fourth section. In the final section some current outstanding problems are discussed. (auth)

28091 (HW-66425) SOME EFFECTS OF NEUTRON RADIATION ON THE MECHANICAL PROPERTIES AND STRUCTURAL CHARACTERISTICS OF HIGH-PURITY IRON. A. L. Bement (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1, 1960. Contract AT(45-1)-1350. 44p.

High-purity iron specimens varying in chemical composition were exposed to neutron radiations to study resultant changes in mechanical properties. Metallurgical investigations revealed that important property changes can be attributed to initial chemical composition, as well as accumulated neutron exposure. It was further discovered that structural responses to strain-aging and damage-recovery treatments vary with irradiation. Reversals in some property changes in the high exposure range revealed that net property changes in irradiated iron cannot be explained exclusively in terms of damage accumulation which approaches saturation. Considerations are given to damage mechanisms, the redistribution of impurities, the causes of gross embrittlement, and the nature of initial plastic yielding. (auth)

28092 (HW-70294) POSSIBLE EVIDENCE OF RADIATION-INDUCED SPLITTING OF GRAPHITE BARS. D. R. de Halas (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 11, 1961. Contract AT(45-1)-1350. 4p.

Observations were made of EGCR graphite moderator blocks in Hanford reactors to determine whether cracking due to radioinduced differential contraction would occur. Although the data were in general inconclusive, tube blocks in the Hanford reactors often contained longitudinal cracks and there is evidence that the frequency of the cracking indicates that radioinduced stresses, rather than outside mechanical forces, may be responsible for the cracking. Recent observations of 2 channels which showed cracks, although they were never previously retubed or subjected to other maintenance forces, gave support to radioinduced stresses as being the cause of cracking. (M.C.G.)

28093 (LA-2463) RADIATION EFFECTS ON LITHIUM HYDRIDE. Frank E. Pretzel, Dwayne T. Vier, Eugene G. Szklarz, and W. Burton Lewis (Los Alamos Scientific Lab., N. Mex.). Sept. 15, 1960. Contract W-7405-Eng-36. 121p.

Extensive measurements of the effects of radiation were made on various compositions of Li hydrides containing combined T. The isothermal expansions of samples exposed to a flux of tritium β radiation equivalent to 16.8 Mr/hr were observed at 12 temperatures between –196° and 400°C for maximum exposures up to 7 years. The results of these measurements were correlated with other data and used to formulate a model for radiation damage in the Li hydrides. That the Li hydrides are essentially ionic in character is shown by various properties. Single crystals of Li hydrides of various compositions were prepared from the melt. These were used to measure various physical properties, such as electrical conductivity, and to study radiation effects on the optical absorption of plates cleaved from the single crystals. The Li hydrides conduct electricity primarily by cation diffusion through a lattice-vacancy mechanism with an activation energy of 0.53 ev in a manner completely consistent with results obtained for the Li halides. The color-center model, which was proposed to explain the effects of radiation damage to the alkali halides, is shown also to be suitable to explain the radiation-induced optical and electron-spin paramagnetic-resonance absorption observed in the Li hydrides. Mechanical properties, phase separation, gas evolution, and other properties of the samples exposed to intense β radiation from combined T were also observed and correlated with the isothermal expansion data to formulate a model for the radiation effects. Equations are presented for the mechanisms involved, and comparisons between simplified calculations based on the model and observed expansion rates are given. One conclusion obtained from these studies was the result that little dissociation and cavitation occurs in samples stored at temperatures below –7°C, whereas these effects are extensive and tend to lead to the disintegration of samples stored at 23°C or higher. (auth)

28094 (NEL-1001) SURVEY OF NUCLEAR REACTORS AND IRRADIATION FACILITIES AND BIBLIOGRAPHY OF RESEARCH ON EFFECTS OF NUCLEAR RADIATION ON ELECTRONIC COMPONENTS AND MATERIALS. J. C. Thompson (Navy Electronics Lab., San Diego, Calif.). Nov. 4, 1960. 118p. (AD-254548)

A resume is given of current knowledge of radiation effects on capacitors, semiconductors, electron tubes, transformers, resistors, and inorganic and insulating materials. Tabulations are included of foreign and domestic reactors, and domestic gamma and neutron facilities. Radiation effects bibliographies are presented for: electronic components; dosimeter compounds and components; seals, gaskets, and sealants; lubricants and fluids; ceramics and glass; metals; plastics; and other materials. (B.O.G.)

28095 (NP-10609) EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES. Quarterly Progress Report No. 4, April 1961 through June 1961. (Lockheed Nuclear Products, Marietta, Ga.). Contract NASw-114. 68p. (NR-126).

A major breakthrough in the testing program resulted from improvements to the extensometer. Most of the round tensile and tensile notch testing for the correlation program was completed. Data from the tests completed during the quarter are tabulated. Development continued on the design of flat specimen grips and the round tensile shear specimen. The refrigeration system to be installed at Plum Brook was

approved by the Safeguards Committee. This system was assembled on the test stand and successfully operated. The major effort on the beam port shield was on thermal, hydraulic, and error analyses to predict the temperature distribution on the external surface of the outer shield. Design modifications indicated by these analyses were made. The maximum calculated temperature predicted for the shield was 264°F. Effort on the sample change system was on design of the controls for the test loop transfer system and on making certain design changes required for approval of the hot cave. Fabrication continued on the airlock and the designs for the cart and bridge were completed. The compressor building and the Quadrant D grating modification were completed. Development of the fission chamber and calorimeter for nuclear measurements in the test loops was completed. (auth)

28096 (REIC-Memo-49) MONTHLY ACCESSION LIST 49 [ON RADIATION EFFECTS DATA]. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Aug. 15, 1961. Contract AF33(616)-7375.

References are given to conference papers, journal items, and reports published from January, 1958 to July, 1961. Brief abstracts are also included, and a list of REIC publications issued is given. (48 references). (P.C.H.)

28097 (SCNC-329) IRRADIATION OF URANIUM-YTTRIUM ALLOYS. S. D. Strauss and J. L. Zambrow (Sylvania Electric Products Inc., Bayside, N. Y.). Aug. 1961. Contract AT-30-1-GEN-366. 31p.

A program for the radiation testing of uranium-yttrium alloys was undertaken upon conclusion of a study of the alloying effects of yttrium on uranium at elevated temperatures. Delineation of test conditions, preparation of in-pile test specimens, and development of the irradiation capsules were completed. Actual irradiation now in progress is expected to give information on the behavior of the 50 wt.% and 75 wt.% yttrium alloys over the temperature range 500 to 900°C under a total fission density of 4×10^{20} fissions/cc. (auth)

28098 EFFECTS OF NEUTRON BOMBARDMENT ON THE INTERNAL FRICTION OF MONOCRYSTALLINE AND POLYCRYSTALLINE ZINC. N. F. Pravdyuk, Yu. I. Pokrovskii, and V. I. Vikhrov. Atomnaya Energ., 10: 347-52 (Apr. 1961). (In Russian)

Neutron bombardment effects on the internal friction of poly- and monocrystalline zinc were studied in order to determine the critical amplitude σ_{crit} before and after exposure. The magnitude σ_{crit} of nascent dislocation movement increased under irradiation due to the reaction of dislocations with local defects. The influence of plane (0001) orientation to the longitudinal axis in monocrystals and σ_{crit} was studied, and the results were correlated with known slip concepts based on monocrystal elongation along the axis. (tr-auth)

28099 BEHAVIOR OF GRAPHITE IN A NUCLEAR REACTOR. V. I. Klimenkov. Atomnaya Energ., 10: 447-60 (May 1961). (In Russian)

Radiation effects in graphite and their influence on reactor graphite construction masonry are analyzed. Certain measures are suggested for preventing these effects. A uniform concept of radiation effects on the physical properties of graphite at a wide range of elevated temperatures and problems of graphite oxidation protection are discussed. (tr-auth)

28100 THE THEORY OF RADIATION EFFECTS ON CERTAIN PROPERTIES OF GRAPHITE. V. M. Agranovich and L. P. Semenov. Atomnaya Energ., 10: 572-6(June 1961). (In Russian)

Irradiation of graphite causes modifications in the crystal lattice of graphite, accompanied by significant changes in its physical properties. This question was studied theoretically by examining the effects of radiation on dimensional changes and on the internal energy of the material. The experimental values were found to oscillate around the calculated data, but at higher exposure levels the theory yielded consistently higher values because the interaction of lattice defects with each other was not taken into consideration. Comparison of the experimental and calculated data also indicated that in all probability all the Wigner energy is not connected with Frenkel defects; only the portion of the Wigner energy which can be annealed out at temperatures up to 800°C is so involved. For complete annealing, temperatures of 1500 to 2000°C, near the recrystallization temperature of the graphite, must be used. (TTT)

28101 RADIATION-INDUCED HARDENING OF MOLYBDENUM. Sh. Sh. Ibragimov and A. N. Vorob'ev. Atomnaya Energ., 11: 65-6(July 1961). (In Russian)

The effect of irradiation by fast neutrons on the microhardness of 99.92% pure Mo in the temperature range of 40 to 70°C was studied in experiments with the BR-2 reactor. With increasing integral dose the microhardness was found to increase continuously, especially strongly at doses higher than 10^{19} n/cm^2. The kinetics of the annealing process of radiation defects was investigated by exposing pure Mo specimens to an integral flux of $1.9 \cdot 10^{20}$ n/cm^2 at temperatures from 150 to 220°C whereby the hardness changed from 197 to 268 kg/mm^2, and subsequently heating the specimens to temperatures beyond 800°C in a liquid Pb-Sn bath. From the results it is concluded that the increase of the hardness is due to two distinct types of defects which can be annealed out by energies of activation of 4500 and 76,000 cal/mol, respectively. These defects have no influence on the electric resistance and accordingly they are not Frenkel type defects. (TTT)

28102 ELECTRON SPIN RESONANCE IN NEUTRON-IRRADIATED QUARTZ. Robert H. Silsbee (Cornell Univ., Ithaca, N. Y.). J. Appl. Phys., 32: 1459-62(Aug. 1961).

The electron spin resonance of one of the defects produced by fast neutron irradiation of crystalline quartz is analyzed. The g tensor and hyperfine tensors deduced from these results imply that the defect electron is in a nonbonding tetrahedral hybrid orbital on a silicon. It is suggested that the instability of the lattice at high doses results in part from the presence of these defects. (auth)

28103 STUDY OF ELECTRON BOMBARDMENT OF THIN FILMS. G. B. Gilbert, T. O. Poehler, and C. F. Miller (Johns Hopkins Univ., Baltimore). J. Appl. Phys., 32: 1597-1600(Aug. 1961).

An experimental study was made of methods by which the physical properties of thin metallic films may be changed. In particular, emphasis was placed on investigating alterations of the crystal structure of certain films subjected to electron bombardment. The films, after being vapor deposited on amorphous substrates, were bombarded by a 35-kev electron beam in a zone recrystallization process. X-ray-diffraction photographs and photomicrographs indicate substantial crystal growth in films of indium, bismuth, and germanium. (auth)

28104 INFLUENCE OF DEFORMATION AND TEMPERATURE ON THE COBALT GAMMA IRRADIATION OF SODIUM CHLORIDE. EVIDENCE FOR ELECTRICAL INTERACTION BETWEEN DISLOCATIONS AND POINT DEFECTS. Rohn Truell (Brown Univ., Providence). J. Appl. Phys., 32: 1601-4(Aug. 1961).

Ultrasonic attenuation measurements in sodium chloride

as a function of Co^{60} gamma irradiation show no appreciable dependence on temperature in the temperature range from room temperature to liquid nitrogen temperature, hence no appreciable thermal activation energy for the process of immobilizing the dislocations. The influence of plastic deformation on the attenuation-irradiation behavior is large; the greater the deformation the more rapid the attenuation change, at least in the deformation range from zero to one percent deformation. The consequences of these effects are discussed in terms of boundary conditions on possible mechanisms for the observed effects. (auth)

28105 STUDY BY ELECTRON PARAMAGNETIC RESONANCE OF POLYVINYL CHLORIDE IRRADIATED BY X RAYS. R. Gautron, J. Roch, M. Ptak, and C. Wippler (Cie de St-Gobain, Antony, France and Ecole Normale Supérieure, St-Cloud, France). J. chim. phys., 58: 649-50 (June 1961). (In French)

The results obtained previously on the decrease in active centers in γ-irradiated polyvinyl chloride after reheating to room temperature are in disagreement with results obtained by others. It appears that the disagreement can be due to a reentry of air into the sample ampules between the end of the irradiation and the EPR measurements. From the results of a repetition of the study it was confirmed that the number of active centers remaining after heating to room temperature is considerable. It is assumed that the variation of the concentration of active centers as a function of time depends on the radiation intensity and the disappearance by monomolecular reaction of these centers. The yield of these centers at 77°K is $G = 0.66 \pm 20\%$, in good agreement with previous results. (J.S.R.)

28106 EFFECT OF NEUTRON IRRADIATION ON CARRIER LIFETIME IN Si. Kenji Matsuura and Yoshio Inuishi (Osaka Univ.). J. Phys. Soc. Japan, 16: 1485(July 1961). (In English)

Effects of neutron irradiation on the carrier lifetime in silicon and its annealing process were observed. Single crystals of n-type Si were irradiated with thermal neutrons, and the recombination decay and thermal release components, with and without bias light illumination, were graphically represented, as well as the isochronal and isothermal annealing data. (L.N.N.)

28107 ELECTRON SPIN RESONANCE IN NEUTRON-IRRADIATED LiF. Kazuo Morigaki (Osaka Univ.). J. Phys. Soc. Japan, 16: 1645(Aug. 1961). (In English)

Studies were made at 4.2 and 1.4°K to determine whether the resonance line is due to more than one magnetic center. By exposing single crystals of LiF at room temperature to thermal neutron doses, it was found that the entire line shape, which is Gaussian at small r-f field, depends on the field intensity. The line width decreased and partially resolved structures became less emphasized with increased r-f field intensity. A similar treatment was performed at 15°C for 15 minutes. The line shape was transformed into Lorentzian and saturated in a smaller r-f field than did the samples before heat treatment. Possible explanations for these phenomena are given, and data are presented graphically. (L.N.N.)

28108 ETCH PITS ON X-RAY DAMAGED ROCHELLE SALT. Kenkichi Okada (Nagoya Inst. of Tech., Nagoya, Japan). J. Phys. Soc. Japan, 16: 1647-8(Aug. 1961). (In English)

Previous investigations of etch pits on x-ray damaged Rochelle salts are summarized. Environmental conditions and theoretical considerations are examined. Photographs of these effects are included. (L.N.N.)

28109 RADIATION DAMAGE TO COPPER SURFACES IRRADIATED BY α RAYS. W. Marth (Laboratorium für Technische Physik, Munich). Kerntechnik, 3: 318-23(July 1961). (In German)

Changes in copper surfaces during irradiation with α rays are examined. For this purpose, a suitable electron-microscopic copying method was developed which permits any number of copies without destroying the object. (auth)

28110 IRRADIATED POLYETHYLENE COMES OF AGE. Robert A. Ward (General Electric Co., Schenectady, N. Y.). Nucleonics, 19: No. 8, 54-7(Aug. 1961).

The changes in the properties of polyethylene upon electron irradiation are reviewed, and the commercial status of the irradiated polyethylene is discussed. Irradiation renders the polymer non-meltable; increases its tensile strength, stress-crack resistance, and transparency; and causes it to shrink upon heating after cold-stretching. (T.F.H.)

28111 NEUTRON ACTIVATION OF THE REACTOR STEEL CONSTITUENTS. COBALT AND MANGANESE DETERMINATION. Lesław Adamski and Krystyna Józefowicz (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 325-34(1961). (In English)

The relative activities of components of typical stainless steel after neutron irradiation are calculated for different exposures and decay times. The determination of cobalt and manganese content in stainless steel by activation analysis is described and results are shown. (auth)

28112 COLOR CENTERS AND RADIATION-INDUCED DEFECTS IN Al_2O_3. Paul W. Levy (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 123: 1226-33(Aug. 15, 1961). (BNL-5382)

The peak energy E_0 and full width U, in ev, of the color centers in Al_2O_3 before irradiation are: $E_0 = 5.45$, $U = 0.6$; $E_0 = 4.84$, $U = 0.54$; with an indication of a band at $E_0 > 6.2$, $U > 0.4$. Irradiation of 3×10^4 r produces saturation of the gamma-ray-induced bands which occur at $E_0 = 5.45$, $U = 1.25$; $E_0 = 3.08$, $U = 1.50$; and probably an additional band at $E_0 = 4.28$, $U = 0.70$. Reactor irradiation produces bands at $E_0 = 6.02$, $U = 0.60$; $E_0 = 5.35$; $U = 0.40$; $E_0 = 4.85$, $U = 0.54$; $E_0 = 4.21$, $U = 0.80$; $E_0 = 3.74$, $U = 0.88$; $E_0 = 264$, $U = 0.64$; and $E_0 = 2.00$, $U = 0.44$. Curves of color-center concentration versus irradiation time for the reactor-induced bands at $E_0 = 6.02$, $E_0 = 5.35$, and $E_0 = 4.85$ can be accurately represented by a saturating exponential plus a linear increase. This behavior is predicted by a simple theory which assumes that the color centers are formed by the coloring of defects present prior to and increased by irradiation and possibly by the coloring of additional centers formed only by radiation damage. The measured rate of defect formation could be consistent with current radiation damage theories; however, several inaccurately known parameters preclude a meaningful comparison. (auth)

28113 DIAMAGNETIC PERTURBATIONS IN MEDIA CAUSED BY IONIZING RADIATION. G. A. Askaryan (Lebedev Inst. of Physics, [Moscow]). Zhur. Eksptl'. i Teoret. Fiz., 41: 186-9(July 1961). (In Russian)

Diamagnetic perturbations in media produced by intense ionizing radiation are studied. It is shown that the diamagnetism is predominantly due to fast electrons. Estimations are presented for the magnetic field perturbations and radio wave splashes due to very high ionizing flares. It is noted that these effects may be employed for distant dosimetry and registration of ionization bursts, investigation of the behavior of fast electrons in a medium, transmission of a force to the medium from an inhomogeneous magnetic field, etc. (auth)

PHYSICS

General and Miscellaneous

28114 (AFOSR-652) FINAL RESULTS OBTAINED IN THE SETTING UP OF THE MOLECULAR GUN. F. Marcel Devienne and J. C. Roustan (Laboratoire Mediterraneen de Recherches Thermodynamiques, Nice). Mar. 1961. Contract AF61(052)-296. 27p.

Modifications were made on the strong-intensity, low-energy molecular ion gun to minimize parasitic collisions, render it more accessible, and obtain better visibility of phenomena. The measurement of the speed of molecules and ions is discussed. (D.L.C.)

28115 (AFOSR-981) ELECTRON MICROSCOPE INVESTIGATION ON THE NATURE OF TRACKS OF FISSION PRODUCTS IN MICA. Technical Note No. 3. G. Bonfiglioli, A. Ferro, and A. Mojoni (Turin. Istituto Elettrotecnico Nazionale Galileo Ferraris). May 1961. Contract AF 61(052)-328. 17p.

To clarify some aspects of the damage caused to crystals by fission products, specimens of different micas were examined using the electron microscope, after suitable bombardment. Biotite, muscovite, and artificial fluorophlogopite and muscovite annealed at 900°C were observed after covering with a thin evaporated uranium layer and irradiation in a reactor up to an integrated flux of 10^5 thermal neutrons/cm^2. Tracks appeared on every specimen but biotite. The respective diameters of the tracks can be put into correspondence with their different resistance to thermal decomposition: larger in muscovite (240A), thinner in fluorophlogopite (150A), and still smaller in dehydrated muscovite (115A). These features supported the view that the mechanism of damage occurs through the heat that is released by the heavy ionizing particles. No tracks were observed in biotite, likely because of too rapid recovery effects. Some recovery effects were also observed in muscovite. (auth)

28116 (AFOSR-1039) APPROXIMATE CONSTANCY OF ADIABATIC INVARIANTS. L. M. Garrido (Saragossa, Spain, Universidad). [1960?]. Contract AF61(052). 21p.

General criteria to be satisfied by a slowly time dependent Hamiltonian in order to possess adiabatic invariants of the m-th order are given. The degree of approximate constancy of such adiabatic invariants was evaluated. These methods were applied to the motion of a charged particle in a magnetic field. (auth)

28117 (AFOSR-TR-60-176) IONIC NATURE OF MOLTEN SALTS. Final Report. George J. Janz (Rensselaer Polytechnic Inst., Troy, N. Y.). Dec. 1960. Contract AF49(638)-50. 14p. (PB-171535)

Experimental apparatus is described for determining the surface tension, density, and electric conductance of molten salts. Comparisons are made between molten salts and aqueous electrolytes, particularly with respect to electric conductances. Ion-core interactions are discussed. (D.L.C.)

28118 (ARL-TR-60-279) ANALYTICAL STUDIES ON ION PROPULSION. R. H. Boden (Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif.). Aug. 1960. Contract AF49(638)-649. 70p. (PB-171305)

Analyses of major problems associated with components of the ion rocket engine system were made. Component studies included electrical power generation systems, thermal power conversion, and accelerating electrode configurations. Analyses of ion beam dynamics, propellant materials, radiation damage to working fluid for a nuclear power plant, and missions using low-thrust vehicles are presented. Interpretation of these analyses is made in terms of engine design parameters. (auth)

28119 (CX-48) A HARTREE SELF CONSISTENT METHOD FOR THE SCATTERING OF POSITRONS BY HYDROGEN ATOMS. Richard S. Ruffine (New York Univ., New York. Inst. of Mathematical Sciences). Apr. 1960. Contracts AF19(604)-4555 and DA-30-069-ORD-2581. 64p. (AFCRC-TN-60-441)

A method was developed for generalizing the Hartree self-consistent scheme used for atomic structure problems so that it may be used for problems of the scattering of electrons or positrons by atomic systems. This method was used to calculate the scattering of positrons by hydrogen atoms. For this problem, there are three coupled differential equations. The effective interaction is made up of a sum of induced multipoles. The system of equations was integrated for s-wave scattering self-consistently on a high-speed computing machine. The method is applicable in principle to the problem of the scattering of electrons by hydrogen and by more complicated atoms. (auth)

28120 (HW-69475) PHYSICS RESEARCH QUARTERLY REPORT JANUARY, FEBRUARY, MARCH 1961. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 20, 1961. 71p.

A survey was made of the experimental data for the cross sections and fission parameters of the fissile nuclides U^{233}, U^{235}, and Pu^{239}. Calculations and measurements of resonance integrals in neutron reactions with lutetium are described. Evidence of the validity of the multithermal group diffusion model of the space-energy distribution of neutrons in moderating media is presented. Further, the ability of the multithermal group model to predict experimental traverses of the thermal activity of non-1/v materials is shown. Material buckling was measured in large-diameter fuel elements in exponential piles for two fuel geometries: hollow and rod-in-tube. The fuel elements were natural uranium with aluminum cladding. A different way to present the results of PCTR experiments in which the fuel in the central cell is heated is discussed. The parameter reported is the change in k_∞ as a function of fuel temperature, $\Delta k_\infty(T)$, rather than the fuel temperature coefficient of k_∞ $(1/k_\infty)$ (dk_∞/dT). The activities of individual foils in a 21-mil stack of copper foils were measured to determine the effect of self-shielding on the resonance corrections. Measurements of k_∞ for 3% enriched uranium–hydrogen moderated homogeneous systems were completed. (M.C.G.)

28121 (MND-P-3015-II) THERMIONIC ISOTOPIC POWER SYSTEMS; SNAP PROGRAMS. Quarterly Progress Report No. 7, Covering Period April 1 through June 30, 1961. (Martin Co. Nuclear Div., Baltimore). Contract AT(30-3)-217. 76p.

An extensive parametric study of cesium-filled converters was completed during the quarter. Cesium-filled test units Nos. 2 and 3 were designed and constructed, and Unit 1 is 85% complete. The prototype vacuum thermionic converter, Unit 2B, was subjected to dynamic testing following its failure due to emitter poisoning. The analysis and design of the curium fuel capsule were completed. (auth)

28122 (NP-10507) SHOCK, VIBRATION AND ASSOCIATED ENVIRONMENTS. PART III. BULLETIN NO. 29.

(Office of the Assistant Secretary of Defense (Research and Engineering), Washington, D. C.)). July 1961. 362p.

The 29th Symposium on Shock; Vibration and Associated Environments was held at the U. S. Naval Supply Center, Oakland, California, November 15-17, 1960.

Twenty-six papers are included; separate abstracts have been prepared for twenty-five. The material is of unclassified nature on the subjects of free-field phenomena, interaction of soils with structures, structural design, and effects on equipment in hardsites. In the study of impact wave propagation in columns of sand, a theory is developed and is treated as an elastic-plastic continuum. This theory assumes that each element of the substance exhibits a strain-rate effect such that the plastic strain rate is proportional to the difference between the compressive stress on the particle and that stress which would act on the element under static conditions. The theory gives satisfactory agreements on two dry sands. (N.W.R.)

28123 (NP-10507(p.1-29)) CRATERING FROM A MEGATON SURFACE BURST. H. L. Brode and R. L. Bjork (RAND Corp., Santa Monica, Calif.).

Assuming a hydrodynamic model, the stresses and early motions associated with the cratering of a rock medium (tuff) from a 2-megaton surface burst are calculated. The results demonstrate the basically two-dimensional geometry of such an explosion and offer preliminary values of the pressures and motions involved. The excavating action is found to be associated with the direct shock from the bomb and not due to the loading, developed by the air overpressures in the early fireball. A limited description of the method, inputs, and equation of state of rock is included. Graphic results, together with some discussion of the salient features and the various physical assumptions and limitations associated with the calculations, are given. (auth)

28124 (NP-10507(p.30-9)) ANALYTICAL AND EXPERIMENTAL STUDIES ON LOCKING MEDIA. Paul Weidlinger (Weidlinger (Paul) Consultants, New York).

A summary of recent researches on stress wave propagation in locking media are presented. Results of analytical and of some experimental work are given and their implication on groundshock phenomena is discussed. (auth)

28125 (NP-10507(p.40-56)) AN EXPERIMENT ON SOILS LOADED DYNAMICALLY BY A SHOCK TUBE. Harold R. J. Walsh (Air Force Special Weapons Center, Kirtland AFB, N. Mex.).

As a part of the program to develop improved methods for design of underground protective structures, the Air Force is conducting a limited number of tests on soil samples using a shock tube as the dynamic loading device. The experimental techniques and procedures found appropriate for those tests, and the extent to which variations in properties of the soil samples are indicated by differences in the measurements made during the tests performed are described. (auth)

28126 (NP-10507(p.57-64)) MOTIONS PRODUCED BY AN EXPLOSION ABOVE A NONHOMOGENEOUS ELASTIC MEDIUM. C. M. Ablow, R. C. Alverson, F. Gair, and F. M. Sauer (Stanford Research Inst., Menlo Park, Calif.).

A finite difference numerical method of determining motions and stresses in an elastic half space due to a time dependent, axially symmetric surface loading is presented. The usual smearing of the compressional and distortional wave fronts in such methods is avoided by introducing a coordinate system following the front. In this characteristic system regions of influence may be traced before determining the actual motion. Numerical results are presented for cases in which the compressional wave speed varies linearly with depth, while the shear wave speed is constant. The method may also be applied to layered media where the elastic parameters are constant in each layer but differ from layer to layer. (auth)

28127 (NP-10507(p.65-74)) A DEVICE FOR DETERMINING DYNAMIC STRESS-STRAIN RELATIONSHIPS OF SOILS. Kenneth Kaplan, James V. Zaccor, and A. B. Willoughby (Broadview Research Corp., Burlingame, Calif.).

A device for the rapid determination of stress and strain in small soil samples under dynamic loading conditions is developed. Stress in the sample can be built up to a constant value in times as short as a few tenths of a millisecond through multiple reflections of the input stress pulse between the two ends of the sample and can be maintained at this level indefinitely. (auth)

28128 (NP-10507(p.76-88)) EQUATIONS OF STATE STUDIES FOR SOIL. Michael A. Chaszeyka (Illinois Inst. of Tech., Chicago. Armour Research Foundation).

The pressure-volume variations of several different solids, from atmospheric pressure to millions of atmospheres, are concisely presented to illustrate the possibilities of compression of solids under pressures which are possible from nuclear explosions. Rankine-Hugoniot equation of state curves are developed for silica glass and an aggregate of the silica glass and air, i.e., a dry sand of silica glass globules, from the isothermal equation of state of the silica glass. The waste heat concept is derived from fundamental thermodynamic principles. The thermal energy corresponding to the entropy change in a shocked porous of solid material is partially wasted in raising the temperature of the material and a small fraction of it is utilized as hydrodynamic energy. Laboratory scale experiments for obtaining equations of state data for soils, up to pressures of millions of atmospheres and down to the elastic pressure range, are described. (auth)

28129 (NP-10507(p.93-9)) PRESENT ROLE OF SOIL DYNAMICS IN THE DESIGN OF UNDERGROUND PROTECTIVE STRUCTURES. G. N. Sisson (Air Force Special Weapons Center, Kirtland AFB, N. Mex.).

Some aspects of the store of knowledge available to the designer of underground protective structures are surveyed. Particular attention is directed to the role of soil mechanics and to the confidence which a designer may place in current theories and empirical methods. (auth)

28130 (NP-10507(p.100-11)) A CONCEPT FOR SOIL-STRUCTURE INTERACTION DUE TO GROUND SHOCK WAVES. A. H. Wiedermann (Illinois Inst. of Tech., Chicago. Armour Research Foundation).

A theory or concept is presented which can be used to estimate the forces acting on a buried structure when the structure is subjected to a ground shock wave. This work was intended to be applicable primarily for soils which are elastic, at least in an approximate manner. (auth)

28131 (NP-10507(p.112-25)) THE EFFECTS OF NUCLEAR EXPLOSIONS ON DEEP UNDERGROUND CYLINDRICAL TUNNELS IN ELASTIC MEDIA. M. L. Baron (Weidlinger (Paul) Consultants, New York).

Stress-time history, velocity, acceleration and displacements produced at and near a tunnel boundary by waves from a 20 MT surface burst are given at various pressure contours. Stresses are shown for both P and S waves. General influence coefficients are presented to allow wider application. (auth)

28132 (NP-10507(p.126-35)) A SIMPLIFIED THEORY OF THE INTERACTION OF SHELL STRUCTURES WITH SOIL. Thomas G. Morrison (American Machine and Foundry Co., Niles, Ill.).

The problem of structure-soil interaction is studied by simplifying the basic problem to its essential elements in order to minimize the mathematics and bring out the essential physical relationships involved. (auth)

28133 (NP-10507(p.136-44)) DYNAMIC STRENGTH OF ROCKS. D. R. Grine (Stanford Research Inst., Menlo Park, Calif.).

Production of new surface area by fracturing of rock behind an explosive-initiated high-amplitude wave is probably an important mechanism for energy absorption in the region near an explosion in rock. Fracturing of rock by high-amplitude pulses and the effects of such fracturing on pulse propagation are considered. (auth)

28134 (NP-10507(p.157-68)) THE EARTHQUAKE GROUND SHOCK PROBLEM AND ITS RELATION TC THE EXPLOSIVE-GENERATED GROUND SHOCK PROBLEM. George W. Housner (California Inst. of Tech., Pasadena).

The earthquake ground shock problem is sufficiently similar to the explosive-generated ground shock problem that the techniques and instruments developed to solve the earthquake problem, such as shock spectra, reed gages, and accelerometers, are applied to the explosive-generated ground shock problem. However, there are certain significant differences, such as in the character of the spectra, in the degree of ground coupling, in the relative scale of phenomena, and in the influence of soil properties, which make the earthquake problem the simpler of the two. It appears that certain difficulties encountered in the earthquake problem which retarded progress may also be encountered in the explosive-generated ground shock problem. (auth)

28135 (NP-10507(p.169-97)) MODEL EXPERIMENTS PERTAINING TO THE DESIGN OF UNDERGROUND OPENINGS SUBJECTED TO INTENSE GROUND SHOCKS. John S. Rinehart (Colorado School of Mines, Golden. Mining Research Lab.).

In these experiments explosives were detonated above openings precast in five brittle rock-like modeling materials. The shapes of the openings and the depths from a free face were varied. The results of some two hundred tests which provide an excellent insight into the nature of failures are described. (auth)

28136 (NP-10507(p.188-223)) DESIGN BELOW GROUND ARCH AND DOME TYPE STRUCTURES EXPOSED TO NUCLEAR BLAST. E. B. Laing and E. Cohen (Ammann and Whitney, New York).

Some of the problems encountered in the design of hardened shallow-buried and earth-mounded arch and dome type structures are discussed. Design equations for determining idealized loadings, frequencies, response values, and stresses are proposed. Effects of change of arch curvature, nonrigid subgrade, arching, and compatibility of edge displacements are discussed. (auth)

28137 (NP-10507(p.224-32)) ANTENNAS FOR HARD RADIO COMMUNICATION SYSTEMS. A PRELIMINARY STUDY. S. P. Morgan and E. E. Zajec (Bell Telephone Labs., Inc., Murray Hill, N. J.).

The study considered in particular the problem of designing radio antennas to survive at the 500-psi point under multiple attacks by nuclear weapons in the megaton range. The study was based upon fundamental physical principles rather than hardening of existing designs. (auth)

28138 (NP-10507(p.233-74)) REVIEW OF BLAST CLOSURE SYSTEMS. Marvin Hassman and Edward Cohen (Ammann and Whitney, New York).

Results are presented of studies made on existing self-acting blast and remote actuated blast closure systems and analyses of available test data. Recommendations are made concerning the various structural and mechanical design parameters. Existing designs are reviewed critically. Limitations of protection afforded by remote actuated designs are presented. It is concluded that maximum system reliability is obtained through the use of self-acting blast actuated valves which are not dependent upon external sensors and are suitable for multibursts. New valve concepts are developed and discussed, with designs presented which have inherent advantages over existing valves, for high-volumetric flow capacities and for combustion-type equipment. The delay path concept is described. An appropriate method is developed for shock flow into plenums prior to valve closure. An orifice method of analysis is developed for flow into a chamber past a valve which is closing. These methods are checked against existing test data and proven to be conservative in all cases. Plenum chambers are sized to limit pressure build-up to 2 psi using the approximate method, for all existing valves studied. Recommendations are made for improvement in valve design and installation. (auth)

28139 (NP-10507(p.275-88)) FOUNDATIONS FOR PROTECTIVE STRUCTURES. K. E. McKee (Illinois Inst. of Tech., Chicago. Armour Research Foundation).

The behavior of foundations subjected to dynamic loads is of major interest to the designers of protective structures. Results are presented of research both analytical and experimental, which considers the behavior of footings under dynamic loads with particular attention to the applications for protective structures. The problems associated with the design and analysis of foundations for protective structures subjected to dynamic loads from nuclear blast are investigated. The behavior of foundations on arbitrary soil subjected to an arbitrary time-dependent force are explained. It is specified that the foundations do not fail which restricts consideration to soil failures. The experiments both static and dynamic, are described and related to the theoretical studies. The results define the limits of current knowledge and make recommendations for design procedures. (auth)

28140 (NP-10507(p.289-98)) PROTECTIVE CONSTRUCTION BY PROVEN COMPONENTS. Ralph H. Sievers, Jr. (Army Engineer Research and Development Labs., Fort Belvoir, Va.).

A flexible system is developed for protective construction design and employment. The principal basis of the system is the use of structures and structural components which have had their resistance to blast effects proven by various nuclear tests. The components, of basic construction materials in prefabricated shapes, are generally such that they can be assembled into a full structure by relatively unskilled labor under competent direction. This system of design is set forth to fulfill a need for flexible and proven designs without full-scale tests on each prototype structure. (auth)

28141 (NP-10507(p.199-303)) CONSIDERATION OF COSTS AND CAPABILITIES OF PROTECTIVE STRUCTURES. R. B. Vaile, Jr. (Stanford Research Inst., Menlo Park, Calif.).

The actual capability of a protective structure is impossible to determine, except by a test which destroys it, and even the design objectives are arrived at only with great difficulty, and commonly with important legitimate differences of opinion. One of the concerns in stating design objectives is the comparison of the importance of strength against a single shot with strength against multiple shots. This comparison is amenable to treatment on a very broad

basis and leads to the conclusion that while it is appropriate to increase the cost of a structure 20 per cent or more to achieve double strength against a single attack, less than a 6-percent increase is justified to give it strength against two attacks rather than one. (auth)

28142 (NP-10507(p.305-23)) NUCLEAR GROUND SHOCKS ENVIRONMENT. Ross W. Dowdy (Daniel, Mann, Johnson and Mendenhall and Associates, Los Angeles).

The design of facilities, which require some degree of resistance to ground shock, has dictated that some reliable and practical method of establishing ground shock information be developed. This need resulted in the initiation of an independent study into the subject which is still in progress. A sufficient number of useful results is achieved to justify a report. A resumé is presented of some methods of isolating an interior structure from ground shock including photographs of some typical installations. (auth)

28143 (NP-10507(p.324-37)) NUCLEAR WEAPON BLAST AND GROUND SHOCK EFFECTS ON DYNAMIC RESPONSE OF INTERIOR COMPONENTS AND EQUIPMENT IN UNDERGROUND STRUCTURES. S. Weissman, E. Cohen, and N. Dobbs (Ammann and Whitney, New York).

The procedures and significant results are presented of studies of the dynamic responses of hardened underground rectangular and silo type structures subjected to megaton nuclear weapons blast and ground shock effects with particular attention to the transmission of shock and vibration to the interior structural components and contents of the structure. Included is a brief general discussion of the structure and soil interaction problem. (auth)

28144 (NP-10507(p.338-47)) A FREE-FIELD STRESS GAGE AND TEST RESULTS IN A NEW 1000-PSI DYNAMIC PRESSURE TANK. T. Winston and J. R. Stagner (United Electro Dynamics, Inc., Pasadena, Calif.).

A free-field stress gage currently under development is described. The gage is tested under static and dynamic conditions to over 1000 psi in a pressure tank. Present test results indicate that the gage reads within 10 percent of the free-field stress up to somewhat beyond 200 psi. It is believed that future gages, developed along the same lines, will accurately measure free-field stresses up to 1000 psi. The design and fabrication of a dynamic pressure tank used in gage development and evaluation is given. (auth)

28145 (NP-10507(p.348-52)) TEST PLANNING FOR SHOCK TESTS OF A HARDENED WEAPON SYSTEM. Henry M. Salisbury (Convair-Astronautics, San Diego, Calif.).

To ensure that hardened silo-type sites can meet the requirements of withstanding an enemy attack, the first site built is to be tested under conditions closely simulating the environment of shock when subjected to an enemy atomic attack. (auth)

28146 (NP-10507(p.353-62)) GROUND SHOCK LOADS IMPOSED ON THE SILO STORED ICBM. Arlyn F. Winemiller (Martin Co., Denver).

The method is illustrated that is used in determining dynamic loads imposed on the silo stored ICBM due to nuclear blast induced ground shock. Some of the more interesting results are presented. The solution of the ground shock loads problem was sought via the passive analog computer. (auth)

28147 (NP-10546) SPACE PROGRAMS SUMMARY NO. 37-9, VOLUME I, FOR THE PERIOD MARCH 1, 1961 TO MAY 1, 1961. (California Inst. of Tech., Pasadena). June 1, 1961. Contract NASw-6. 104p.

Lunar Program. A spacecraft vehicle compatibility test was completed on the Ranger RA-1 proof test model and Agena No. 6001. Development of telecommunications and instrumentation for Rangers RA-1 to -5 is described. Planetary-Interplanetary Program. The development of Mariner A is discussed in detail, and the status of other projects is outlined. Deep Space Instrumentation Facility. Results of the Venus radar contact experiment are reported. Radar ranging experiments on Echo passes are also reported. Operation of the Goldstone and Woomera tracking stations is discussed. Juno II. The status of the Juno II program, which has sent up ten satellites, is reviewed. (D.L.C.)

28148 (NP-10548) ASTRONAUTICS INFORMATION. Abstracts Vol. IV, No. 1. Abstracts 4,001-4,100. B. J. Hardgrove, E. H. Sands, and F. L. Warren, comps. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). July 1961. Contract NASw-6. 37p.

Abstracts are presented on flight dynamics, vehicle technology, communications, guidance and control, manned flight, space medicine, and space science. Also included are author, subject, and source indexes. (100 abstracts.) (J.R.D.)

28149 (NP-10551) THE CONTINUOUS PHOTOELECTRIC ABSORPTION CROSS SECTION OF HELIUM. Technical Report No. 5. D. J. Baker (Cornell Univ., Ithaca, N. Y.). July 1961. Contract Nonr-401(37). 23p.

Measurements were made of the continuous photoelectric absorption cross section of helium. Observations were made in the spectral range extending from 180 to 600 Å. For all of the photographic measurements, the radiation source consisted of a condensed spark discharge in a glass capillary. It was necessary at each wavelength to determine the ratio of intensities incident upon and transmitted by the gas sample. The value of the cross section derived from these measurements was 0.98 ± 0.04 mb at 180 Å. The value of the cross section rose with increasing incident photon wavelength. (M.C.G.)

28150 (NP-10573) QUARTERLY PROGRESS REPORT NO. 62, [ON ELECTRONICS]. H. J. Zimmermann, G. G. Harvey, and W. B. Davenport, Jr. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). July 15, 1961. 319p.

Research activities for the quarter ending July 15, 1961 are reviewed. Progress is indicated in the fields of physical electronics, plasma dynamics, low temperature physics, microwave spectroscopy, nuclear magnetic resonance and hyperfine structure, microwave electronics, molecular beams, statistical communication theory, processing and transmission of information, speech communication, mechanical translation, linguistics, communication biophysics, neurophysiology, neurology, network synthesis, and computer components and systems. (M.C.G.)

28151 (NP-10578) ON THE SUPERPOSITION OF PERIODIC POTENTIALS AND HOMOGENEOUS FIELDS. Technical Report No. 1. G. H. Wannier and D. R. Fredkin (Oregon Univ., Eugene and Bell Telephone Labs., Inc., Murray Hill, N. J.). [nd]. Contract NONr 2771(05). 14p.

Wave functions are constructed for a superposition of a periodic electric potential and a uniform magnetic field. The wave functions are not themselves solutions of the Schroedinger equation, but yield the traditional effective hamiltonian. Contrary to the electric field case the manifold of states linked by the band index does not form a Bloch band; the reason is that the cellular transforms of the Bloch-like functions are modified by the Peierls phase. The derivation of these results is in closed form, but justifiable only to all powers of the magnetic field. The limita-

tion may not be genuine. The existence of closed Bloch bands in the presence of a homogeneous electric field is proven; the case of free electrons is given as an example. One expects from this that the new results for the magnetic field are at least in part also independent of the power series method used for their justification. (auth)

28152 (NP-10598) ASTRONAUTICS INFORMATION, OPEN LITERATURE SURVEY, VOLUME IV, NO. 1, ENTRIES 40,001-40,202. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). July 1961. Contract NASw-6. 40p.

References alphabetized according to subject are given to periodicals published from winter, 1960 to July, 1961. Separate author and subject indexes are also included. (202 References) (P.C.H.)

28153 (NP-10617) ION AND ATOMIC BEAMS IN SPACE. Final Report. Robert L. Carroll (American Machine and Foundry Co. Advanced Research Dept., Alexandria, Va.). Aug. 14, 1961. Contract DA-36-039-SC-78961. 118p.

Analysis of the problem of space charge dispersion of a charged ion beam indicates that the limitations imposed by this effect are quite severe. Beam dispersion due to random thermal velocity distribution is analyzed. It is found that this effect is not as severe as that of space charge dispersion. However, it appears that the limit of use of the beam for communications will be of the order of a few thousand miles at most. It is indicated that this limit can be extended if the particle velocity is near that of light or if the generation temperature is near absolute zero. The effects of Rayleigh, Thompson, and Compton scattering of light by beam particles in the presence of the radiation field of the sun are analyzed. It is found that these effects are negligible in relation to those of space charge and thermal dispersion. It is concluded that radiation pressure effects are quite small. The analysis of solar winds and particle clouds in space indicates that the beam particle mean free path is quite large so that there is no significant limitation imposed by their presence. However, these particles constitute a background of "noise" so that beam dispersion by space charge and thermal effects will impose an adverse signal-to-noise ratio upon the information carried. Thus it appears that the presence of the particles imposes a limit upon the density reduction which can be tolerated in the beam. The problem of neutral beam generation is discussed. The recombination coefficient is developed as a function of temperature and density and a possible mechanism for neutral beam generation is shown. It is indicated that the problems are rather severe. The possibility of employing the "pinch effect" upon a beam in the presence of the atmosphere is discussed. It is concluded that this is not feasible since the pinch is unstable even if it occurs. Power requirements for any sustained operation are in the megawatt range. Use of the radiation produced by impact ionization of the atmosphere by means of a beam is analyzed. This is shown to be impractical on the basis of beam power requirements. Possible applications of the beam to propulsion, power transfer, and warfare are indicated. It is concluded that propulsion offers the best possibility. A propulsion unit based upon the use of a-c power is presented. Deviation and dispersion of the beam in electrostatic and magnetic fields in space are analyzed. Although some of the effects are fairly severe for charged beams, the limitations imposed are not as great as those already found. The geometrical problems of aiming a beam to strike a target in the fields in space are considered. Solutions are given for uniform fields and for inverse square attractive and repulsive fields. The analysis of the magnetic case is limited to the uniform field. The general conclusion reached is that long-range communications by the use of ion beams in space is not feasible. (auth)

28154 (RISÖ-27) THE EQUILIBRIUM STATE OF THE GAS BEHIND A STRONG HYDROGEN SHOCK. C. T. Chang (Denmark. Atomenergikommissionen. Forsogsinstitut, Risö). July 1961. 32p.

The equilibrium states of the gas behind a strong hydrogen shock are computed for ranges of shock Mach numbers. The results show that the vibrational degree is fully excited when the temperature exceeds 3×10^3°K and ionization becomes noticeable only after the gas is completely dissociated. In the relaxation region, a continuous temperature drop occurs. When there is ionization, the pressure exhibits a minimum before attaining the final equilibrium value. The influence of the initial conditions and of the partition functions on the equilibrium state of the gas is discussed. (D.L.C.)

28155 (TID-13493) STUDIES OF H_2^+ DISSOCIATION. Quarterly Progress Report No. 3, May 15, 1961 through August 14, 1961. A. W. Ehler (Hughes Aircraft Co. Hughes Research Labs., Malibu, Calif.). Aug. 31, 1961. Contract AT(04-3)-362. 3p.

Investigations are being made of the dissociation by intense electrical fields of H_2^+ ions in highly excited vibrational states. A current was detected by the electron multiplier in the H^+ ion detection chamber. Measurements were carried out to determine if this was caused by the dissociation of H_2^+. (M.C.G.)

28156 (UCRL-6467) OSCILLATING VERTICAL MAGNETIC DIPOLE ABOVE A CONDUCTING HALF-SPACE. James Paul Wesley (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 2, 1961. Contract W-7405-eng-48. 17p.

The electromagnetic field produced by a vertical oscillating magnetic dipole above a plane conducting earth is obtained in integral form. An exact solution in closed form is obtained for the case in which the dipole and the point of observation are both located on the surface of the earth. (auth)

28157 (AEC-tr-4502) THE PHYSICS OF X-RAYS. (Fizika Rentgenovskikh Luchei). Second, Revised Edition. M. A. Blokhin. Translated from a publication of the State Publishing House of Technical-Theoretical Literature, Moscow, 1957. 429p.

Basic principles of the physics of x rays necessary for further study of the special problems of the applications of x rays in science and industry are presented. Topics covered include: systematics of x-ray spectra, intensity of x-ray spectra, form and width of lines of an x-ray spectrum, true absorption of x rays, optical properties of x rays, the photoelectric effect and secondary spectra, scattering of x rays, fine structure of emission and absorption spectra, and contemporary methods of investigating a material by x-ray spectra. (M.C.G.)

28158 (JPRS-7816) SELECTED TRANSLATIONS FROM WU-LI HSUEH-PAO (ACTA PHYSICS SINICA) APRIL-MAY 1959—COMMUNIST CHINA. Translated from Wu Li Hsüeh Pao, 15: Nos. 4, 5, 167-72; 173-7; 202-9; 219-29; 254-61; 269-76 (Apr.-May 1959). 79p.

Translations of 6 articles are presented. Topics covered include the cup electrode solution arc method of spectrographical analysis, spectrochemical analysis of alloy steels, determination of carbon arc temperature by using CN vibrational band spectrum, strange particles, decay products, distribution from particle of arbitrary spin, and mass dif-

ference between neutron and proton. Separate abstracts were prepared for three of the articles. (M.C.G.)

28159 (JPRS-8182) PHYSICS RESEARCH IN COMMUNIST CHINA. Translated from Wu Li Hsüeh Pao, 15: No. 10, 521-4; 535-49; 559-64; 565-74(Oct. 1959). 78p.

Translations of 6 selected articles are included; 3 have been previously abstracted in NSA. The three papers not abstracted are: Ten Years' Development of Physics in China, Spectroscopic Analysis of Steel and of Carbon, The Vibrational Spectra of Rochelle Salt. (D.E.B.)

28160 (UCRL-Trans-698(L)) THE TEMPERATURE DEPENDENCE OF THE PHOTOEMISSION OF THE Cs–Sb PHOTOCATHODE IN THE TEMPERATURE REGION OF –170°C UP TO +20°C. Zs. Naray. Translated by George A. Condas for Univ. of California from Ann. Physik (6) 20: 386-9(1957). 5p.

The temperature dependence of the photoeffect of the Cs–Sb photocathode was examined at –170 to +20°C. In the neighborhood of the limiting wavelength a monotonic fall of sensitivity was found with increasing temperature. At shorter wavelengths in a wide temperature region the sensitivity is dependent on the temperature and a steeper fall of sensitivity is only produced at the lowest temperatures. (auth)

28161 AXIOMATIC DEVELOPMENT OF THE LAWS OF VACUUM ELECTRODYNAMICS. R. H. Lehmberg (Univ. of Arizona, Tuscon). Am. J. Phys., 29: 584-92 (Sept. 1961).

The laws of classical vacuum electrodynamics are derived from three postulates relating to interactions among charges. Two of these describe the behavior of a moving test charge in an electrostatic field. Application of relativistic arguments to these two yields the Lorentz force law and Maxwell's equations for unaccelerated charges. The third postulate states that these laws are unaltered if the source charges are accelerated. The experimental basis of this postulate is discussed, and is found to be generally inconclusive. (auth)

28162 DEVELOPMENT OF THE KINETIC THEORY OF GASES. V. THE EQUATION OF STATE. Stephen G. Brush (Univ. of California, Livermore). Am. J. Phys., 29: 593-605(Sept. 1961). (UCRL-6006)

Early attempts to explain deviations from the ideal gas laws are discussed. After a general survey of 19th-century work on the equation of state, the work of Ritter (1846), Clausius (1870), and van der Waals (1873) is discussed in detail. Ritter used Poisson's formula to include the virial of interatomic forces in the caloric theory of gaseous pressure; Clausius introduced similar methods in the kinetic theory. Combined with the Maxwell-Boltzmann distribution law, the virial theorem provided a systematic procedure for calculating the pressure from any assumed force law. Van der Waals used more intuitive methods for taking account of the effect of finite molecular size and attractive forces. The success of his equation led to a large amount of work on the equation of state, but rigorous deductions from definite molecular models did not begin until around 1900. (auth)

28163 DYNAMICS OF IONIZED GASES. Bernard Steginsky (Battelle Memorial Inst., Columbus, Ohio). Am. J. Phys., 29: 605-16(Sept. 1961).

The dynamics of a classical, ionized gas is presented stressing the role of individual particles in contributing to the gross behavior of the gas. A distinction is drawn between a weakly ionized and a strongly ionized gas, and it is shown how the latter, through long-range interaction forces, exhibits collective behavior. Three methods of description employed in the study of ionized gases are reviewed; the microscopic theory, the velocity-distribution method, and the macroscopic theory. Part of the section on the macroscopic theory is devoted to a consideration of the special case of a perfectly conducting gas in order to illustrate typically the pitfalls which may be encountered in a narrow application of the continuum approach to magnetohydrodynamics. (auth)

28164 DEFINITION OF MACROSCOPIC ELECTROSTATIC FIELD. Allan N. Kaufman (Univ. of California, Livermore). Am. J. Phys., 29: 626-30(Sept. 1961). (UCRL-6273)

The electric field of the macroscopic Maxwell equations is described as the mean of that of the microscopic Maxwell equations. By "mean" is meant either a volume average or a statistical average, the result being the same. The electrostatic field is considered, and it is shown that the mean microscopic field is not appropriate for use in the concept of dielectric constant. A suitable definition of macroscopic field is discussed, and it is shown that it differs from the mean microscopic field in a nonuniform medium. (auth)

28165 APPLICATIONS FOR LOW-POWER NUCLEAR ROCKETS. Ralph S. Cooper (Los Alamos Scientific Lab., N. Mex.). Astronautics, 6: No. 8, 34-6; 66; 68-9(Aug. 1961).

Performance and applications of low-power nuclear rockets powered by fast-reactor engine concepts are discussed. The tungsten-based low-power (less than 2000 mw) fast reactor rockets offer high performance in many missions starting from orbit with a 25-ton vehicle. The reactor used is compared to those for graphite-moderated reactors and chemical (O_2-H_2) engines. The shielding requirements for fast reactors and the effects of shielding upon vehicle operations are also discussed. (N.W.R.)

28166 THE STAGNATION-POINT BOUNDARY LAYER IN THE PRESENCE OF AN APPLIED MAGNETIC FIELD. William B. Bush (Space Technology Labs., Inc., Los Angeles). J. Aero/Space Sci., 28: 610-11; 630(Aug. 1961).

Equations are developed that are not subject to the previous restrictions of small values of the magnetic parameter and constant electric conductivity across the boundary layer. (L.N.N.)

28167 THERMIONIC ENERGY CONVERTERS. B. A. Ushakov. Atomnaya Energ., 10: 343-6(Apr. 1961). (In Russian)

Direct conversion of nuclear energy into electric energy, based on thermionic devices, is investigated. Various materials possessing good thermo-emission properties are analyzed, and results of tests with a converter in an active reactor zone are reported. The experiments demonstrate that during operation an inert gas filled converter becomes a cesium plasma diode, eliminating the use of cesium vapors and improving the performance and life of the converter. (tr-auth)

28168 ROTATING PLASMA JET IN A DISCHARGE IN A MAGNETIC FIELD. A. V. Zharinov. Atomnaya Energ., 10: 368-9(Apr. 1961). (In Russian)

A staggering in relation to ion-electron current rise was observed with a probe in a critical magnetic field. Further experiments were carried out in order to determine the relation of a critical magnetic field H_{crit} to the pressure and type of gas. Graphs showing H_{crit} variations as a function of pressure in argon, hydrogen, and nitrogen and the plasma jet rotation time as a function of magnetic field intensity are plotted. (R.V.J.)

28169 A GRAPHIC METHOD FOR THE DETERMINATION OF THE ACTIVITY OF IRRADIATED SPECIMENS. S. Popov (Lab. for the Application of Radioisotopes and Machine Construction, Sofia). Atomnaya Energ., 11: 61-5 (July 1961). (In Russian)

If one gram of material with known atomic weight and activation cross section is irradiated in a known thermal neutron flux for a time t, then the activity of the material at the time of its reception by the customer after a period t_1 after stoppage of the irradiation can be expressed by a function with 2 variables $A = f(t,t_1)$ which can be represented in a spatial coordinate system. Using a logarithmic scale for the time periods and the activity, times ranging from 1 min to 70 days and all the practically occurring activity levels may be conveniently included. By using the graphs calculated for the isotopes with known half life values obtained during the irradiation, the activity of the specimen can be easily computed graphically for t and t_1 values varying from 1 to 10^5 minutes. The method is usable also for more complicated alloy systems. Cast iron and W are used as examples for calculating the activities. (TTT)

28170 MASS SPECTROMETRIC STUDY ON ADSORPTION OF WATER VAPOR ON A GRAPHITE SURFACE. Hokotomo Inouye (Kochi Univ., [Japan]). Bull. Chem. Soc. Japan, 34: 643-8(May 1961). (In English)

Peak shapes in mass spectra are characterized by the places of formation and the initial kinetic energy of the ions. Thus, it is possible to decide the place of formation of the ions and, though not so precisely, to estimate their initial kinetic energy from the shape of the peak. The method was applied to the ions formed by electron bombardment at a graphite surface covered with adsorbed water vapor, and the results were as follows: H_2O^+ and HO^+ were formed from residual or desorbed H_2O only in the gas phase; H_2^+, H^+, and CO^+ were formed both on the surface and in the gas phase; and H^+ which formed on the surface had the initial kinetic energy of about 10 v. The results confirm the fact that the adsorbed water molecule is dissociated into adsorbed H_2 and surface oxide of carbon that probably takes a configuration such that CO is adsorbed on the surface. (P.C.H.)

28171 PROTON SPIN-LATTICE RELAXATION IN POLYATOMIC GASES. M. Bloom, M. Lipsicas, and B. H. Muller (Univ. of British Columbia, Vancouver). Can. J. Phys., 39: 1093-1109(Aug. 1961).

The proton spin-lattice relaxation time T_1 was measured in gaseous samples of methane, ethylene, and ethane as a function of pressure at room temperature and also at 193°K for methane. In the pure gases T_1 is proportional to density, ρ, at low densities indicating that intramolecular interactions couple the spin systems to the lattice, as is the case in hydrogen gas. T_1/ρ at low densities gives information on the mean square angle through which the molecules are rotated per collision. Relaxation due to paramagnetic O_2 is observed at higher densities when oxygen gas is added as an impurity. The relaxation probability per collision with an oxygen molecule is about 5 times larger for the ethylene–oxygen system than for the other two systems studied. This anomaly is discussed in terms of the theory of Oppenheim and Bloom. It is shown that a study of the temperature dependence of T_1 due to O_2 impurities provides a new way of obtaining detailed information on the Lennard-Jones parameters for the interaction between O_2 and the solvent molecules. (auth)

28172 ALFVÉN WAVES IN PARTIALLY IONIZED GASES. Tomiya Watanabe (Univ. of Maryland, College Park). Can. J. Phys., 39: 1197-1211(Aug. 1961).

The conditions for a wave, propagated in a partially ionized gas along an external magnetic field, to be of Alfvén type have been obtained. (auth)

28173 ION PRODUCTION IN CATHODE REGION OF GLOW DISCHARGE. A. M. Rezikyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 13: No. 6, 63-72 (1960). (In Russian)

A method, independent of cathode theory, is developed for determining the region producing ions that reach the cathode sheath. The method does not indicate the exact spot of ion appearance, but it is capable of determining the mean ion track reaching the cathode. The mean length is computed as the mean linear track of all ions appearing in discharge and reaching the cathode. The results achieved with argon at 5 mm mercury are presented. The mean length $\bar{S}_k = 0.08$ cm. (R.V.J.)

28174 PROPAGATION AND REFLECTION OF SPHERICAL SHOCK WAVE IN UNBOUND ELASTIC MEDIUM. O. Kh. M. Oliev. Izvest. Akad. Nauk Azerbaidzhan. S.S.R., Ser. Fiz.-Mat. i Tekh. Nauk, No. 4, 35-45(1960). (In Russian)

The reflection of spherical shock waves from an unbound elastic semi-space was analyzed. The propagation and reflection of spherical shock waves produced by shock pressure p(t) on the surface of an expanding zone inside the medium is also studied. The latter event occurs with an explosion or shock in a fragile medium. (R.V.J.)

28175 AXIALLY SYMMETRIC MOTIONS OF A GAS EXHIBITING STRONG SHOCK WAVES IN A MAGNETIC FIELD. I. P. Malyshev. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekh. i Mashinostr., No. 3, 182-3 (May-June 1961). (In Russian)

The motion of a gas traveling at supersonic velocities is treated by assuming that the gas flow is non-turbulent, adiabatic, and is driven into shock waves electrically while its conductivity remains constant. Under these assumptions the magnetic field is expressed as $H = H\varphi(r)i\varphi$, such that $H\varphi(r) = (J/2\pi)(1/r)$. Equations describing the flow of such a gas at lower than supersonic velocities are taken from a book by G. G. Chernyĭ (Gas flow at Supersonic Velocities, Fizmatgiz, 1959, (In Russian)) and are dimensionally analyzed with suitable modifications to describe the case for supersonic flow. The equations were then solved on the computer "Strela." The solution of the equations shows that the motion reduces to that of a turbulent flow of a supersonic gas in a magnetic field radiating cylindrical pulses due to the infinite pressures generated by the shock waves. These pulses are called motion pulses. Joule heat losses are shown to be negligible through the conservation of energy. Results of the calculations are plotted as dimensionless ratios. It is shown that the ratio of the speed of the shock waves in the presence of the magnetic field to the speed of the shock waves in the absence of the field is given by $(U_2(H)/U_2) = (r_2(H)/r_2)$ which is independent of the field strength. (TTT)

28176 LUMINESCENCE OF SEMICONDUCTOR CRYSTALS IN EXCITATION IN THE REGION OF ABSORPTION SPECTRUM DISCRETE STRUCTURE. I. S. Gorban, S. N. Rud'ko, and A. A. Shishlovskii. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 6-12(Jan. 1961). (In Russian)

Luminescence spectra of Cu_2O crystals with various specific resistances measured at 20 to 77°K are tabulated. The absorption and luminescence properties of HgI_2 specimens prepared by different methods are compared with the data on Cu_2O. In contrast to the Cu_2O, the intensity of the HgI_2 short-wave band increases and the long-wave band

intensity diminishes when the temperature was increased from 20 to 70°K. (R.V.J.)

28177 EFFECTS OF ADDITIVES ON MOLECULAR CRYSTAL LUMINESCENCE AT LOW TEMPERATURES. M. T. Shpak. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 13-19(Jan. 1961). (In Russian)

Simple multinuclear aromatic compounds (diphenyl, terphenyl, quatrephenyl, etc.), compounds with benzene nuclei bound with hydrocarbon atoms (dibenzene, stilbene, etc.), compounds with condensed benzene nuclei (naphthalene, anthracene, phenanthrene, etc.), and their derivatives; and deuterium substituted substances of these compounds were used in the tests. At very low temperatures the crystal spectra demonstrated general resonance excitation of the additives and crystal that obscure the luminescence spectra of the crystal itself. Considerable spectrum variations were observed with increased additives. (R.V.J.)

28178 MECHANISM OF THE ENERGY ACCUMULATION BY PHOSPHOR CRYSTALS. Ch. B. Lushchik, G. G. Liid'ya, and I. V. Yaek (Inst. of Physics and Astronomy, Academy of Sciences, Estonian SSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 23-7(Jan. 1961). (In Russian)

An analysis is made of mechanisms of energy accumulations by phosphor crystals. The long-lasting excitation state process, the mechanism of center coloring, and thermal and optical de-excitation of crystals are studied. The absorption and F center spectra are plotted for KCl–Ca Tl; KBr–Ga; KbR–In; and KBr–Tl. The optical and thermal analyses show that the thermal disintegration of NaCl, KCl, and KBr crystal F centers at 100 to 300°K is related to hole forming processes and at 400 to 500°K to electron processes followed by shifting of ion vacancies (ion-electron processes). (R.V.J.)

28179 EFFECTS OF ISOSTRUCTURE ON ACTIVATED MIXED CRYSTAL SPECTRA. F. D. Klement and L. A. Teiss. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 28-30 (Jan. 1961). (In Russian)

The influence of isostructure on the emission spectra of KCl · KBr-Tl crystals is analyzed at various fixed ratios of KCl and KBr. The short-wave band for 80% KCl · 20% KBr 0.05 Tl is plotted for 240 to 265 mμ excitation. Emission spectra of 87% KCl · 13% KBr-Tl at various Tl concentrations (0.0005, 0.019, and 0.2 mol %) were also plotted. The data indicated that the absorption spectra are influenced by the transitions in Tl^+, where energy levels are deformed by Cl^- or Br^- fields, and that specific interactions of Tl^+ with Cl^- and Br^- result in two-center luminescence. (R.V.J.)

28180 INVESTIGATION OF LUMINESCENCE PROCESSES IN ALKALI-HALIDE PHOSPHORS. L. M. Shamovskii and P. A. Pipinis. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 31-7(Jan. 1961). (In Russian)

Mechanisms of recombination were studied with NaBr-In and KBr-In phosphors activated by mono- and trivalent indium bromide. The curves of thermal de-excitation of NaBr-In excited by light in activated absorption bands at various temperatures are analyzed, and the curves are correlated with the exo-electron emission (F band) in KBr-In phosphors excited by cathode beams at −155°C. The depths of capture levels in KBr-In and NaBr-In are evaluated on the basis of thermal de-excitation data. The analysis of thermoluminescence, exo-electron emission, and optical scintillation shows that with any method of excitation the de-excitation corresponds to hole recombination. The luminescence centers are "atomic" centers. (R.V.J.)

28181 MECHANISM OF OPTICAL SPARK DAMPING. I. A. Parfianovich and E. I. Shuravleva (Irkutsk State Univ., [USSR]). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 38-42(Jan. 1961). (In Russian)

The kinetics of optical spark damping was investigated with x-ray excited NaCl-Ni phosphors. The curves of optical spark damping stimulated by light in the F-band region indicate that increases in activator concentration and in temperature slow the damping. The slowest damping in the initial stage was observed in phosphors with the highest activator concentrations. The variations in luminescence during irradiation are described by a reduced probability of free electron–luminescence center recombination due to m-center blocking and by a reduced number of ionized luminescence centers during irradiation. The relation of optical and thermal luminescence power also depends on the concentration of the activator and on the degree of excitation. The luminescence is complex and is determined by electron accumulation on the small capture levels and by variations in the utilization of reserved luminescence power by the centers of luminescence. (R.V.J.)

28182 EXCITATION OF ACTIVATED ALKALI IODIDE LUMINESCENCE AT LOW TEMPERATURE. M. L. Kats, K. E. Gyunsburg, and L. I. Golubentseva. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 43-4(Jan. 1961). (In Russian)

Excitation spectra of KI-SnI_2 and NaI-Sn at +20 to −150°C and NaI-Sn and KI-Pb at −150° were studied. The excitation spectra of KI-Sn indicate absorption excitation with a 219 mμ maximum and an increasing intensity at lower temperatures. It was shown that the intensity of 219 and 229 mμ bands increase with increased activator. Interaction processes between excitons and activated centers result in luminescence center excitation and in single ionized or atomic centers in phosphors with divalent activators. (R.V.J.)

28183 ATOMIC CENTERS IN NaCl–Ag AND KBr–Ag PHOSPHOR CRYSTALS. V. K. Nickol'skii (Saratov State Univ., [USSR]). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 45-6(Jan. 1961). (In Russian)

Absorption spectra of prepared NaCl-Ag (up to 20 mol % activator) polycrystals exhibit in addition to the ordinary band, a wide band with a maximum at ~300 mμ. Moreover, the appearance spectra and the maximum position depend on the rate of cooling. The absorption spectra of x-irradiated and light decolorized monocrystal show a tendency for A and A′ center combination with C centers, producing a double atomic center bound by dipole attraction during the increase of activator concentration from 1 to 10 mol %. The maximums in x-irradiated crystals containing 1, 25, and 10 mol % AgCl are found at 565, 550, and 545 mμ. A similarity was found between the optical properties of atomic centers in x-irradiated NaCl-Ag monocrystals and the luminescence of NaCl-Ag polycrystals with a high activator concentration. An additional absorption maximum at 300 mμ is formed in KBr-AgBr monocrystal with 5% AgBr. It is postulated that atomic centers ordinarily formed in colored crystals can also form without irradiation in silver activated alkali halide crystals. (R.V.J.)

28184 LUMINESCENCE OF NON-ACTIVATED ALKALI IODIDES. N. N. Vasil'eva and Z. L. Morgenshtern. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 47-50(Jan. 1961). (In Russian)

Spectral distributions of KI, KI-Tl, KI-In crystals under γ excitation at liquid nitrogen temperature and at room temperature were investigated. The results show for KI, one ultraviolet emission band with λ_m ~370 mμ; for crystals with high Tl concentration, one activated band with λ_m ~406 mμ; for crystals with small Tl concentration, the band λ_m ~382 mμ, assumed to be composed of two bands,

one thallium and the other ultraviolet. For crystals activated by small concentrations of In there are two bands, one ultraviolet and the other an activator long-wave band. With increased In concentration, the intensity of the ultraviolet band diminishes and the activator band increases. At very large concentrations of In and Tl the ultraviolet band completely disappears. (R.V.J.)

28185 POLARIZATION PHENOMENA IN PHOTOEFFECT. B. A. Lysov (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 1, 71-6(1961). (In Russian)

A generalization of the Sauter-Sommerfeld formula for the relativistic photoeffect from the K-shell, considering circular γ polarization, was developed by the Born method. The prerequisite for consideration in the second Born approximation is indicated. A general formula describing the degree of longitudinal photoelectron polarization was derived using the theory of Dirac particles with oriented spin. (tr-auth)

28186 ORIENTATION-DEPENDENT DISSOLUTION OF LITHIUM FLUORIDE. M. B. Ives (Carnegie Inst. of Tech., Pittsburgh). J. Appl. Phys., 32: 1534-5(Aug. 1961).

It is shown that the etch rate of lithium fluoride crystals in both a modified CP-4 etchant and a dilute aqueous solution of ferric fluoride is a function only of crystallographic orientation. This conclusion is reached by comparing experimental observations with the results of a recent topographical theory of crystal dissolution. (auth)

28187 FERMI MOMENTUM FOR FREE ELECTRON METALS PERTURBED BY LOCALIZED IMPERFECTIONS. Akira Sugiyama (Nagoya Technical Coll., Japan). J. Phys. Soc. Japan, 16: 1327-36(July 1961). (In English)

The Fermi momentum k_m and the interior density ρ_i are calculated for free electron metals perturbed by localized imperfections, and the Thomas-Fermi relation $\rho_i = k_m^3/3\pi^2$ is verified up to the higher order. Then it is shown that the Friedel theorem can be based on the above relation. When the Fermi momentum k_m is expressed in terms of the phase shift η of the free electron wave function, the charge neutrality condition in the interior leads to the Friedel sum rule for the case of the plane surface as well as of the point imperfection. (auth)

28188 MICROWAVE STUDY OF NON-IONIZING SHOCK WAVES. Susumu Takeda (Nagoya Univ., Japan) and Michel Roux. J. Phys. Soc. Japan, 16: 1395-1402(July 1961). (In English)

The interaction of microwave with gaseous plasmas is used to study weak shock waves in low pressure gases. In order to study by this method shock waves of low Mach number, which are incapable of ionizing the gaseous medium in which they propagate, this medium is weakly preionized. In a tube of 5 mm in diameter, condenser discharges are fired for the production of shock waves up to 200 joules, in a pressure range of 4-13 mm Hg in neon and argon and with Mach number up to 5, and it is found that the measured electron density increase across the discontinuity is in the ratio of the gas density ratio. The electron temperature, deduced from the measured electron-ion collision frequency, is, as expected, lower than the gas temperature estimated from the Mach number. (auth)

28189 ON THE COMMENCEMENT OF THE HARTMANN FLOW OF CONDUCTING FLUID. Akira Ogawa (Osaka City Univ.) and Yoshio Sone. J. Phys. Soc. Japan, 16: 1423-6(July 1961). (In English)

The effect of the transverse magnetic field on the commencement of the two-dimensional Poiseuille flow of conducting fluid between two parallel walls is discussed. Owing to the invariance of the flow characteristics in the direction parallel to the walls, the fundamental equations reduce to linear equations and can be solved exactly. Several limiting cases are surveyed on the basis of the solution obtained. Detailed numerical calculation is also made for a special case in which the values of the Reynolds number, the magnetic Reynolds number and the pressure number are all equal to unity. (auth)

28190 TEMPORARY BLEACHING OF COLOR CENTERS IN KCl CRYSTAL. Masamitsu Hirai, Mikihiko Ikezawa, and Masayasu Ueta (Tohoku Univ., Sendai, Japan). J Phys. Soc. Japan, 16: 1477-8(July 1961). (In English)

A KCl crystal additively colored and containing F centers with a concentration of $2.7 \times 10^{16}/cm^3$ was cleaved to a piece of dimensions $6 \times 7 \times 10$ mm^3. The crystal was illuminated by F-light at room temperature to produce M, N, and R centers and was cooled to 90°K and illuminated. Absorption and absorption changes were measured and the results were represented graphically. With the decrease of the F band, the M and N bands decreased. (L.N.N.)

28191 MÖSSBAUER EFFECT OF THE INTERMETALLIC COMPOUND UFe_2. Shigehiro Komura, Nobuhiko Kunitomi, Poh-Kun Tseng, Naomoto Shikazono, and Hidekuni Takekoshi (Japan Atomic Energy Research Inst., Tokyo). J. Phys Soc. Japan, 16: 1479(July 1961). (In English)

The hyperfine field at the position of Fe^{57} nuclei in UFe_2 was measured by means of the Mössbauer effect. The transmission through the powdered UFe_2 sample of 14.4-kev gamma rays emitted from Co^{57} incorporated in silicon was observed at liquid nitrogen temperature as a function of the velocity of the gamma-ray source. The estimated value of the hyperfine field at room temperature was estimated to be 20 ± 8 kilo-oersteds. The absorption pattern at liquid nitrogen temperature spread broadly and the intensity of the two outermost absorption lines is three times larger than that of the two central lines indicating values of less than 65 kilo-oersteds for the hyperfine field of Fe^{57} in UFe_2. (L.N.N.)

28192 ON THE INTERFERENCE PHENOMENA OF COMPTON SCATTERING FROM DIAMOND. Yasuharu Yoneda (Kyushu Univ., Fukuoka, Japan). J. Phys. Soc. Japan, 16: 1570-4(Aug. 1961). (In English)

The divergent beam pattern due to Compton scattering is explained. The pattern is not caused by a point source of x rays outside the crystal but by interference of x rays produced uniformly in a small crystal. It is shown experimentally that the interference lines can appear even for a pretty small crystal if a micro-beam is used. (auth)

28193 IONIZATION EFFICIENCY CURVES FOR A^+, Kr^+, N_2^+, AND CO^+ BY ELECTRON IMPACT. Yozaburo Kaneko (Tokyo Metropolitan Univ.). J. Phys. Soc. Japan, 16: 1587-93(Aug. 1961). (In English)

The shape of ionization efficiency curves obtained by essentially monoenergetic electrons is studied by means of the threshold law. In the curves for N_2^+ and CO^+, some humps attributed to autoionization processes are found. These processes occur at 16.2 ± 0.1 ev for N_2^+ and at 15.6 ± 0.1 and 18.4 ± 0.1 ev for CO^+. Though the shape of the curve for Kr^+ is similar to that of Fox et al. and Frost et al., it is difficult to interpret this shape by autoionization process only. The curve for Ar^+ shows large tailing of 0.50 ± 0.05 ev which can not be explained by a ground state doublet. The ionization potentials determined for rare gases and some diatomic molecules agree well with spectroscopic values and the previous electron impact data. (auth)

28194 TWO-DIMENSIONAL SUPERSONIC JET OF A CONDUCTING INVISCID GAS IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD. Shigeki Morioka (Ritumeikan Univ., Kyoto). J. Phys. Soc. Japan, 16: 1625-30(Aug. 1961). (In English)

The behavior of the two-dimensional supersonic jet of an ideal gas with weak electric conductivity in the presence of a uniform magnetic field is considered on the basis of the linearized theory. In general, the boundary of the jet can be expressed by the formula which contains the terms yielding the monotonic change of the width of the jet and its deflection due to the inclination of the lines of force in addition to the term in the ordinary gas dynamics. The expressions for these terms are shown explicitly. (auth)

28195 STEADY TEMPERATURE IN A COMPOSITE ELLIPTIC CYLINDER. Václav Vodička. J. Phys. Soc. Japan, 16: 1630-6(Aug. 1961). (In English)

Classical methods are used to determine the steady temperature distribution in a finite elliptic cylinder consisting of any number of plane-parallel layers. As illustration of the general procedure, the case of a homogeneous isotropic elliptic cylinder is treated in some detail. (auth)

28196 MOLECULAR AUTORADIOGRAPHY PERFORMED BY MEANS OF ILFORD AND NIKFI EMULSIONS IN GEL FORM./ S. Aurisicchio (Università, Rome), A. Celano, and R. Rinzivillo. Nuovo cimento (10), 18: Suppl. No. 2, 179-89(1960). (In English)

Radiography of small particles, biological materials, and macromolecules using beta-sensitive gel emulsions is discussed, and processing facilities and methods are described. Beta particles from the small particle studied form stars in the emulsion, each prong produced by an electron; thus the number of marked atoms in the particle is revealed. The "thorium star" method and the "blob counting" method are described, and the processing bath compositions are given. (T.R.H.)

28197 ANOMALIES IN IONIZATION COEFFICIENTS AND IN UNIFORM FIELD BREAKDOWN IN ARGON FOR LOW VALUES OF E/p. D. E. Golden and L. H. Fisher (New York Univ., New York). Phys. Rev. 123: 1079-86 (Aug. 15, 1961).

Prebreakdown ionization currents in argon have been measured in uniform fields for low values of the ratio of field strength to pressure E/p[5 to 12 v (cm mm Hg)$^{-1}$]. Currents obtained with varying electrode separation d at constant E/p and constant p could not be analyzed to yield values of the Townsend coefficients a/p and γ. Currents obtained with varying p at constant E/p and constant d could be analyzed to yield values of a/p and γ, but such currents yielded coefficients which depend on d. The dependence of the values of a/p on d is attributed to the production of highly excited atoms by resonance radiation at some distance from the positions where the electrons lose their energy; these highly excited atoms then produce molecular ions and electrons in collisions with ground-state argon atoms. The secondary mechanism and the dependence of γ on d are associated with resonance radiation. Sparking potential measurements in argon made by varying both p and d for values of pd corresponding to breakdown for the above range of E/p show deviations from Paschen's law. Disregarding the above anomalies, the values of a/p are smaller than the earlier measurements of Kruithof and Penning by as much as a factor of 15 at E/p = 5 (d = 4 cm). At this value of E/p (and of d), the value of exp(ad) at breakdown is only 1.05, and the value of γ is about 20. At larger values of E/p, the present values of a/p become independent of d and approach theirs. The sparking potentials obtained are significantly larger than those obtained by Kachickas and Fisher. This is shown to be due to the condition of the cathode surface. (auth)

28198 SELF-CONSISTENT PAIR INTERACTION FOR MANY-FERMION SYSTEM. Katuro Sawada and Toshio Soda (Univ. of California, La Jolla). Phys. Rev., 123: 1087-99(Aug. 15, 1961).

The equations which determine the one-particle energy and effective two-body interaction in an interacting Fermi gas are constructed within the approximation which sums up all pair creation-annihilation processes. The equation corresponds to the familiar equation for the K matrix which represents the interaction between particles (or holes) and sums up the particle-particle (or hole-hole) scattering processes. The method of the equation of motion is used in this paper. Our result for the one-particle energy is shown to lead to the result previously obtained by Quinn and Ferrell, and by Rockmore for the case of the electron gas with Coulomb interactions, when we replace screened potentials by bare potential in the self-consistent energy equation. For nuclear matter, it is shown that the presence of an attractive interaction in the equation of motion for number density causes an "enhancement" of exchange forces, whereas in the electron gas repulsive Coulomb interactions lead to "screening" of the exchange force. The strength of the isospin density interaction pseudopotential is enhanced by a factor of two when one solves the self-consistent equation; and a simple estimate shows that the Goldhaber-Teller mode lies about 15% higher than the value $p_F q/m$ previously estimated by Glassgold et al. (q: momentum of the oscillation, p_F: Fermi momentum). (auth)

28199 SUPERCONDUCTING CRITICAL FIELD OF TANTALUM AS A FUNCTION OF TEMPERATURE AND PRESSURE. C. H. Hinrichs and C. A. Swenson (Ames Lab., Ames, Iowa). Phys. Rev. 123: 1106-14(Aug. 15, 1961). (IS-264)

The results of precise critical field measurements on tantalum samples which show "soft" superconducting behavior are given along with direct measurements of the pressure effect, $(\partial H_c/\partial P)_T$, as a function of temperature. The Bardeen-Cooper-Schrieffer theory is used as a guide in the extrapolation of these data to absolute zero from 1.1°K. The advantages of using an H^2 vs T^2 representation for both the critical-field and pressure-effect data are discussed, and it is shown that if both sets of data can be represented in terms of power series [H^2 or $(\partial H_c^2/\partial P)_T$ vs T^2] over a limited range of temperature, it is then possible to write down explicit power series expressions for the differences in the thermodynamic functions between the normal and superconducting states over this same temperature range. The electronic contributions to the specific heats and the thermal expansions for tantalum are calculated from the experimental data. (auth)

28200 SUPERCONDUCTIVITY OF α- AND β-MERCURY. J. E. Schirber and C. A. Swenson (Ames Lab., Ames, Iowa). Phys. Rev., 123: 1115-22(Aug. 15, 1961). (IS-263)

Precise critical field measurements and a direct measurement of $(\partial H/\partial P)_T$ as a function of temperature were made on physically identical samples of α- and β-Hg. The purpose of these measurements was to obtain data on the effects of crystal structure on the properties of superconductors, and to permit calculation of various thermodynamic quantities difficult to obtain in any other way. The critical fields of the two phases were found to be identical when expressed in terms of the reduced variables H/H_0 and T/T_c. No generalizations of this type could be found to explain the

pressure effects. The advantages of an H^2 vs T^2 and $(\partial H^2/\partial P)$ vs T^2 analysis for extrapolation to absolute zero are stressed. The critical fields of several representative superconductors are compared with the critical field predicted by the Bardeen-Cooper-Schrieffer theory, using a plot that emphasizes the detailed shape of the curves at low temperatures. This plot also can be interpreted in terms of the θ/T_c dependence of the width of the energy gap. The agreement between calorimetric and critical field determinations of the electronic specific heat in the normal state is shown to be improved by using the H^2-T^2 extrapolation. The volume dependence of the reduced energy gap is shown to be very small for those superconductors for which pressure effect data are available. (auth)

28201 ELECTRONIC STRUCTURE OF THE F CENTER IN LiCl. R. F. Wood and J. Korringa (Ohio State Univ., Columbus). Phys. Rev., 123: 1138-44(Aug. 15, 1961).

The electronic structure of the F-center lattice defect in LiCl is investigated with calculations based on the usual model of the F center proposed by de Boer. The ground- and excited-state wave functions and energies of the trapped electron are determined by two different methods. First, the method of linear combination of atomic orbitals (LCAO) is used. This method is capable of yielding good results but the complexity of the necessary calculations is great. In an effort to avoid this complexity the method of vacancy-centered wave functions is investigated. Very simple wave functions are used in this method with satisfactory results. The coefficient of the hyperfine interaction of the F-center electron with the nearest-neighbor lithium ion and the oscillator strength of the optical transition are calculated. The distortions of the lattice in the vicinity of the F center are calculated. A very small outward movement of the first and second nearest neighbors occurs in the ground state. The situation in the excited state is complicated by the "p-type" symmetry of the F-electron wave function. In this case, the two nearest-neighbor lithium ions located on the symmetry axis of the wave function are found to undergo a large displacement outward from the vacancy. The other four nearest neighbors displace inward toward the center of the vacancy. The results of the calculations are discussed and detailed comparisons with other work of a similar nature are given. (auth)

28202 INTERPRETATION OF LOW-ENERGY DIFFRACTION PATTERNS OF ADSORBED GASES. Ernst Bauer (Michelson Lab., China Lake, Calif.). Phys. Rev., 123: 1206-8(Aug. 15, 1961).

Recent observations of the adsorption of oxygen on nickel are interpreted in terms of double scattering processes instead of the single scattering mechanism which has been used in all previous interpretations. This permits a single explanation of the observed variation of the intensity of the diffraction pattern with electron energy and provides a plausible understanding of the early stages of adsorption. (auth)

28203 MAGNETIC ANOMALY IN $FeTiO_3$-αFe_2O_3 SYSTEM BY MÖSSBAUER EFFECT. S. L. Ruby (Westinghouse Electric Corp., East Pittsburgh, Penna.) and G. Shirane. Phys. Rev., 123: 1239-40(Aug. 15, 1961).

The solid solutions $(1-x)FeTiO_3$-xFe_2O_3 exhibit strong ferrimagnetic moments for the compositions $x < 0.6$, where the Fe and Ti ions are ordered in the alternate (111) layers. The anomaly revealed by the Mössbauer measurements is that the ferrimagnetic phase consists of ferrimagnetic clusters surrounded by paramagnetic media. The size of these clusters decreases with increasing temperature or increasing local concentration of Ti. The isomer shift of $FeTiO_3$ is 1.2 mm/sec at room temperature as expected for Fe^{2+}, although the quadrupole splitting of 0.62 mm/sec is smaller than that observed in other ferrous environments. (auth)

28204 SPECULAR REFLECTION IN THE DIFFRACTION OF SLOW ELECTRONS NEAR NORMAL INCIDENCE. J. P. Hobson and I. H. Khan (National Research Council, Ottawa). Phys. Rev., 123: 1241-2(Aug. 15, 1961).

During experiments on the diffraction of slow electrons (0-180 ev) at normal incidence, a diffracted beam was observed corresponding to the direction of specular reflection; i.e., straight back along the incident direction. This beam had properties indicating that it should not be considered as a limiting case of beams diffracted at other colatitude angles. Maxima in reflected intensity of this beam were observed at 4, 16, and 31 ev incident energy. The target used was a single crystal of tungsten with the (110) face exposed. Ultrahigh-vacuum techniques were employed. (auth)

28205 ELECTRON WAVE FUNCTIONS IN METALLIC SODIUM. Joseph Callaway (Univ. of California, Riverside). Phys. Rev., 123: 1255-6(Aug. 15, 1961).

Wave functions to order k^2 are presented for electrons in metallic sodium. The calculation is an application of the cellular method. The empirical potential of Prokofjew was employed. (auth)

28206 EFFECT OF PERIODIC ADIABATIC TIME VARIATIONS ON INTERACTING SYSTEMS. H. Suhl (Univ. of California, La Jolla). Phys. Rev., 123: 1262-4(Aug. 15, 1961).

It is shown that a many-particle system subject to periodic adiabatic variation of certain of its parameters is to a certain extent equivalent to a non-time-varying system with a radically modified interaction between the particles. The particular case of an electron gas in a metal is discussed in some detail. (auth)

28207 "REPULSION OF ENERGY LEVELS" IN COMPLEX ATOMIC SPECTRA. R. E. Trees (National Bureau of Standards, Washington, D. C.). Phys. Rev., 123: 1293-1300(Aug. 15, 1961).

Rosenzweig and Porter have shown a "repulsion of energy levels" in spacing distributions determined from energy levels in complex atomic spectra. The present paper extends their work by showing that these spacing distributions can be determined from calculated positions of the levels in these spectra. Since calculated data are available for spectra where the observed data are scarce or incomplete, this partially overcomes limitations imposed by statistical inaccuracy when direct use is made of the observed data. The equivalence of the two approaches is demonstrated by showing that calculated data for Ta II yield the same spacing distribution as obtained from observed data for Ta II and Re I combined. These are complex spectra in which a fully developed repulsion effect is present. A similar demonstration of equivalence is carried out for spectra of Ru I and Mo I, where the repulsion effect is in an intermediate state of development. The results also indicate that numbers easily evaluated from the radial parameters of the theory will indicate roughly the degree of repulsion, replacing to some extent the need for an explicit calculation of the spacing distribution. (auth)

28208 X-RAY DEFICIENCY IN MESONIC ATOMS. Y. Eisenberg (Weizmann Inst. of Science, Rehovoth, Israel) and D. Kessler. Phys. Rev., 123: 1472-7(Aug. 15, 1961).

An analysis is presented of π-mesonic atoms, based upon cascade calculations taking into account the known processes of radiation, Auger transitions, and nuclear absorption. This analysis, together with the previous one on μ-mesonic

atoms, is intended to provide a deeper insight into the unsolved problem of the deficiency of x rays in mesonic atoms. It is shown that the π-mesonic L x-ray yields (for $Z \leq 20$) are quite insensitive to the strength of nuclear absorption and depend only upon the chosen initial meson population of the higher levels. Similarly, the ratios of basic (K_α, L_α, etc.) to higher x-ray yields, both for μ and π mesons, depend strongly on the initial distribution. The best agreement between the calculations and experiment was obtained for a "modified statistical" initial population of the form $(2l + 1)e^{al}$, with $a = 0.2$, in the $n = 14$ level. From the existing experimental data on π-mesonic K x rays, the mean life of the π meson in nuclear matter was deduced: $\tau_c = 2.75 \times 10^{-23}$ sec. Within the framework of the present theory no account can be made for the x ray deficiency in the light atoms. However, it is shown that the quantum loss as a function of energy is different for π- and μ-mesonic atoms, and therefore it is very probably due to a real physical effect. Furthermore, by comparing our predicted Auger electron yields with the experimental data, we can rule out any hypothetical simple Auger process in which the full energy of the "missing" quantum is given to a single electron. (auth)

28209 THE LENNARD-JONES 6-12 POTENTIAL PARAMETERS OF H_2 AND D_2. H. F. P. Knaap and J. J. M. Beenakker (Kamerlingh Onnes Laboratorium, Leiden). Physica, 27: 523-30(June 1961). (In English)

The difference in the Lennard-Jones potential parameters between H_2 and D_2 is calculated. This effect arises mainly from a difference in polarizability. The results agree with experimental data. Similar calculations are performed on the ortho and para modifications, and the calculated effect can account for the major part of the difference in gaseous and liquid properties between the two species. (auth)

28210 A SELF-CONSISTENT SET OF MOLECULAR PARAMETERS FOR NEON, ARGON, KRYPTON AND XENON. G. Boato and G. Casanova (Università, Genoa and Istituto Nazionale di Fisica Nucleare, Genoa). Physica, 27: 571-89(June 1961). (In English)

A self-consistent set of molecular parameters ϵ and σ for heavier inert gases is determined, on the assumption of the validity of a universal two-body law of interaction and therefore of the applicability of the quantum theorem of corresponding states. Vapor pressure data on isotopic pairs and other experimental data are used for this purpose. The new set of parameters is used for plotting experimental data on various reduced properties versus the quantum parameter $\Lambda^* = h/\sigma\sqrt{m\epsilon}$. The theorem of corresponding states is found to be obeyed to a high degree of approximation. (auth)

28211 THE σ-STARK EFFECT OF ROTATIONAL TRANSITIONS. PART I. EXPERIMENTAL ASPECTS. A. Dymanus and H. A. Dijkerman (Rijksuniversiteit, Utrecht). Physica, 27: 593-602(June 1961). (In English)

A method is described for the automatic recording of the Stark-splitting patterns of microwave transitions corresponding to $\Delta M = \pm 1$. The application of the method to the $J = 1 \rightarrow 2$ rotational transition of the $O^{16}C^{12}S^{32}$ molecule is described in the ground state and the excited bending (l-doublet) vibrational state. Generally, splitting patterns can be recorded automatically over frequency intervals up to 400 Mc. Slight distortion of the line shapes and of the relative intensities cannot be avoided, however. (auth)

28212 ON THE KINETICS OF THE APPROACH TO EQUILIBRIUM. I. Prigogine and P. Resibois (Université Libre, Brussels). Physica, 27: 629-46(July 1961). (In English)

The diagram technique combined with the formalism of the resolvent was applied in order to establish the general equations of the evolution of a classical gas starting with the Liouville equation. Some equations useful to all the orders in the coupling parameter and in concentration and for all periods was obtained. For short periods the equations are non-Markovian and take into account the finite time interval of a collision; in the limit of long times ($t \rightarrow \infty$), they lead to asymptotic Markovian expressions obtained previously in the study of the approach to the equilibrium. The relation between that theory and the scheme proposed by Bogolioubov is briefly discussed. Finally, it is shown that, for the calculation of the transport coefficients, the non-Markovian characteristic of the kinetics of the approach to equilibrium does not play a part; these coefficients are wholly determined by the asymptotic cross sections. (tr-auth)

28213 ON THE INTERNAL CONSISTENCY OF THE HYPER-CHAIN APPROXIMATION IN THE THEORY OF CLASSICAL FLUIDS. G. S. Rushbrooke and P. Hutchinson (King's Coll., Newcastle-upon-Tyne, Eng.). Physica, 27: 647-56(July 1961). (In English)

The hyper-chain approximation in the theory of classical fluids, and a second approximation in which some account is taken of the first elementary diagram, are examined for internal consistency by calculating virial expansions of the pressure both directly and from the compressibility equation. Both theories are internally inconsistent at the fourth virial coefficient. Numerical results are presented for both fourth and fifth virial coefficients for a gas of hard spheres and compared with those given by earlier treatments. A brief comment is made on the consistency of the equations for fluid mixtures. (auth)

28214 ON THE APPROACH TO NON-EQUILIBRIUM STATIONARY STATES AND THE THEORY OF TRANSPORT COEFFICIENTS. R. Balescu (Université Libre, Brussels). Physica, 27: 693-706(July 1961). (In English)

A general formula for the time dependent electric current arising from a constant electric field is derived similarly to Kubo's theory. This formula connects the time dependence of the current to the singularities of the resolvent of Liouville's operator of a classical system. Direct contact is made with the general theory of approach to equilibrium developed by Prigogine and his coworkers. It constitutes a framework for a diagram expansion of transport coefficients. A proof of the existence of a stationary state and of its stability (to first order in the field) are given. It is rigorously shown that, whereas the approach to the stationary state is in general governed by complicated non-markoffian equations, the stationary state itself (and thus the calculation of transport coefficients) is always determined by an asymptotic cross section. This implies that transport coefficients can always be calculated from a markoffian Boltzmann-like equation even in situations in which that equation does not describe properly the approach to the stationary state. (auth)

28215 MULTIPLE QUANTUM TRANSITIONS. P. Jung (European Research Associates, Brussels). Physica, 27: 707-9(July 1961). (In English)

Comparison is made of the multiple-quantum formulation with Bloch's phenomenological theory, and application is mentioned in the case of magnetic transitions where one quantum is large and the others are comparable to line width. Diagrams of the apparatus used for the production of second order transitions and of the derivative of absorption are given. (L.N.N.)

28216 THE RELATION BETWEEN ELECTROMAGNETIC AND GRAVITATIONAL INTERACTIONS. S. Thya-

garaja Rao (Univ. of Madras). Proc. Indian Acad. Sci., Sec. A., 53: 323-31(June 1961). (In English)

A new formulation of the electromagnetic interaction between charges is given using a relative interaction Lagrangian formalism. This leads to all the well-known effects in current electricity, but predicts, in addition, a variation of inertial mass with potential. In the analogous equations written for gravitation also, the inertial mass is changed by the potential energy. These equations explain the gravitational phenomena usually explained by general relativity, namely, the precession of the Mercury perihelion, gravitational deflection of light and the red-shift. The agreement between theory and experimental observations is fair. The results are incorporated in tabular form. (auth)

28217 MANY-ELECTRON THEORY OF ATOMS AND MOLECULES. Oktay Sinanoglu (Yale Univ., New Haven). Proc. Natl. Acad. Sci. U. S., 47: 1217-26(Aug. 1961).

In the many-electron theory of atoms and molecules, electrons are shown to affect one another through their instantaneous potentials and not just by their average potentials as in the Hartree-Fock method. The situation of the many-electron problem in atoms and molecules is compared with related many-body problems. A theory for the N-electron atom or molecule was developed to obtain a quantitative scheme of the order of difficulty of the He, H_2 case, to understand the physical behavior of many-electron motion and to relate the "chemical" picture to correlation. Physical aspects of correlation in atoms and molecules are discussed. (M.C.G.)

28218 SPIN-LATTICE RELAXATION IN IMPERFECT CUBIC CRYSTALS AND IN NON-CUBIC CRYSTALS. E. R. Andrew and D. P. Tunstall (University Coll. of North Wales, Bangor, Wales). Proc. Phys. Soc. (London), 78: 1-11 (July 1, 1961).

An examination is made of the spin-lattice relaxation in the solid state of nuclei whose energy level spacings in a magnetic field are rendered unequal by quadrupole interactions with the crystalline electric field. Attention is directed to two special cases: (1) when the main magnetic field is suddenly increased from zero, and (2) after saturation of the central line of the resonance spectrum; in the case of imperfect cubic crystals this is the only observed line. In general, 2I relaxation times characterize the relaxation behavior, though in the two special cases the effective number is reduced. Detailed calculations of the relaxation behavior have been made for spin number $\frac{3}{2}$ and $\frac{5}{2}$ for a quadrupolar relaxation mechanism. The behavior in the two special cases differs and to a degree which depends on the relative strength of quadrupolar relaxation by transitions involving $\Delta m = 1$ and 2. The relevance of the results to the experiments of Day and Squire on potassium iodide is discussed. Magnetic relaxation is also treated and an expression is found for the 2I relaxation times. (auth)

28219 REFLECTION AND POLARIZATION OF ELASTIC WAVES IN A LiF CRYSTAL: MODE CONVERSION FROM LONGITUDINAL TO TRANSVERSE. N. Joel (Universidad de Chile, Santiago). Proc. Phys. Soc. (London), 78: 38-45(July 1, 1961).

An experiment is described in which a longitudinal wave of ultrasonic frequency travelling in a crystal of LiF (anisotropic medium) is incident on a crystal–air boundary and is reflected as a transverse wave. Such a mode conversion, or complete change in the state of polarization, of an elastic wave had previously been observed only in isotropic media. The corresponding calculations are also given; they agree with the experimental results. (auth)

28220 THE g_j VALUE OF THE 6^3P_1 LEVEL IN MERCURY. J. N. Dodd (Univ. of Otago, Dunedin, N. Z.). Proc. Phys. Soc. (London), 78: 65-9(July 1, 1961).

A redetermination of the g_j value of the 6^3P_1 level in mercury using the double-resonance technique is described. The value is in agreement with recent measurements using the level-crossing technique but not with the value obtained in earlier experiments. A weighted mean of all determinations suggests the value $g_j = 1.48631 \pm 0.00008$. (auth)

28221 LINE SHAPES IN THE METHOD OF INTERSECTING ENERGY LEVELS. B. P. Kibble and G. W. Series (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 78: 70-4(July 1, 1961).

The changes of intensity of the resonance fluorescence from mercury vapor as a small magnetic field H is applied either parallel or anti-parallel to the direction of the incident light were studied. The changes follow either a Lorentzian or a dispersion-type function of the Zeeman splitting of the excited state, according to the orientations of polarizer and analyzer in the beams of light. In an experiment with an additional oscillatory field at a frequency ω_0, similar curves are observed in the region $H = H_0/2$. (H_0 is the field for which ω_0 is the Larmor frequency.) The observations are relevant to a recently developed technique in which intensity changes of this sort are used to make precision measurements in spectroscopy. The Lorentzian line shape is usually observed. The possibility of obtaining line profiles of other shapes was pointed out by Franken. (auth)

28222 PRE-BREAKDOWN IONIZATION IN HYDROGEN AT LOW PRESSURES. S. C. Haydon and A. G. Robertson (Univ. of New England, Armidale, New South Wales, Australia). Proc. Phys. Soc. (London), 78: 92-102(July 1, 1961).

Detailed studies of pre-breakdown ionization in hydrogen gas at low pressures were made in the presence of uniform electric fields and appropriate analytical methods and experimental procedures suitable for similar studies in crossed electric and magnetic fields were established. The factors influencing determinations of the first Townsend ionization coefficient α/p_0 from pre-breakdown ionization measurements are discussed and an observed pressure dependence of α/p_0 at $E/p_0 = 350$ is shown to be due to the presence of vapor impurities which can give rise to the large values of α/p_0 recently reported. Values of α/p_0 have been measured for the range of values of E/p_0 from 50 to 450 v cm^{-1} (mm Hg)$^{-1}$. (auth)

28223 THE UNRESTRICTED HARTREE-FOCK METHOD. W. Marshall (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 78: 113-19(July 1, 1961).

The unrestricted Hartree-Fock method is a convenient method of calculating neutron form factors and hyperfine interactions, but because the method gives wave functions which are not eigenfunctions of S^2, the validity of it must be questioned. It is shown that the unrestricted Hartree-Fock method gives spin densities which are approximately correct to first order provided certain exchange energies are small relative to promotion energies. Furthermore, it is shown that the wave functions obtained must be used directly and that it is a poor approximation to project out the unwanted parts after the energy minimization procedure has been performed. (auth)

28224 THE STABILITY OF VISCOUS FLOW BETWEEN ROTATING CYLINDERS IN THE PRESENCE OF A MAGNETIC FIELD. [PART] II. S. Chandrasekhar and Donna

D. Elbert (Univ. of Chicago). Proc. Roy. Soc. (London), 262: 443-54(Aug. 8, 1961).

The theory developed in an earlier paper (Chandrasekhar, 1953) is extended to allow for counter-rotation of the two cylinders. Explicit results are given for the case when the two cylinders rotate in opposite directions with equal angular velocities. (auth)

28225 ON THE COMPLETENESS PROBLEM FOR THE EIGENFUNCTION FORMULAE OF RELATIVISTIC QUANTUM MECHANICS. E. C. Titchmarsh (Proc. Roy. Soc. (London), 262: 489-502(Aug. 8, 1961).

Dirac's theory of relativistic quantum mechanics leads to the problem of solving a set of four partial differential equations for the four components of the wave function. Solutions of these equations in the case where the potential is a function of the radial co-ordinate only were obtained by Darwin. It is proved that these solutions form a complete set in the sense that we can simultaneously expand four arbitrary functions in terms of them. (auth)

28226 THE ION BALANCE OF THE OXYGEN d.c. GLOW DISCHARGE. J. B. Thompson (Plessey Co., New Lane, Havant, Hants, England). Proc. Roy. Soc. (London), 262: 519-28(Aug. 8, 1961).

Previously reported measurements of electron energy distribution and ion concentrations in the positive column of an oxygen discharge are used as a basis for discussing the ion equilibrium. The degree of dissociation is shown to be of order 10% and reasons are advanced for the view that negative ions O^- are destroyed in the gas phase by collision with oxygen atoms. A double-sheath criterion is established for an electronegative plasma applicable to the boundary sheaths of striations in the positive column. The ion densities required to satisfy this criterion are not in general the same as those set up by the combined action of generation by electron impact and wall loss with the result that the positive column is unstable. (auth)

28227 RELATIVISTIC SELF-CONSISTENT FIELDS. I. P. Grant (U.K.A.E.A., Aldermaston, Berks, England). Proc. Roy. Soc. (London), 262: 555-76(Aug. 8, 1961).

The equations of the relativistic self-consistent field are discussed using the algebra of tensor operators. The coefficients of radial integrals in the formula for the energy are written in terms of Clebsch–Gordon and Racah coefficients, so that their symmetries are seen and their numerical values are calculated with the use of published tables. The magnetic interaction between two electrons is considered as well as the electrostatic interaction, and the effect of this term on the ionization energy of a K electron in mercury is computed with the results of Mayers. (auth)

28228 ON THE KINETIC EQUATION FOR ELECTRONS IN METALS AT LOW TEMPERATURES. Tohru Morita (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 845-7 (May 1961). (In English)

The one-particle Wigner function for electrons is calculated, to the first order of the external electric field, in order to obtain the conductivity of metals. It is a linearized Boltzmann equation of the Markovian type, in which the external field is replaced by the internal field and the interactions are screened. The kinetic equation is reduced to the one used to obtain metal conductivities at low temperatures if collisions between electrons are neglected and interactions of the screened ones are adopted as the interactions, or if the screening is neglected. (L.N.N.)

28229 GENERAL THEORY OF SUPEREXCHANGE INTERACTION. Mitsuru Fukuchi (Electrical Communication Lab., Tokyo). Progr. Theoret. Phys. (Kyoto), 25: 939-55 (June 1961). (In English)

Mechanisms of superexchange interaction in a magnetic compound are investigated by using the second quantization method which was originally developed by Bogolyubov in the polarized-ion model for metals. The electron-field operator is expanded by a set of orthogonalized atomic orbitals which are constructed from the original non-orthogonal ones. By taking into account the configuration interaction the energy of the crystal is evaluated up to the fourth order of the overlap integral between the nearest neighbor orbitals. The coupling between spin pairs, which is obtained in the order of ϵ^4, is shown to be descirbable by the familiar spin-operator formalism. The effective interaction constant J has really a very complicated structure owing to non-orthogonality of the original orbitals. It is observed that J contains the interaction in $\pi/2$-direction besides the usual interaction in π-direction. (auth)

28230 GENERAL THEORY OF SUPEREXCHANGE INTERACTION. [PART] II. Mitsuru Fukuchi (Electrical Communication Lab., Tokyo). Progr. Theoret. Phys. (Kyoto), 25: 956-63(June 1961). (In English)

The method developed to treat superexchange interaction in a magnetic compound is extended to include the excited-state orbitals, and new contributions to the spin-dependent energy are obtained. (auth)

28231 AN EXPANSION THEOREM FOR THE ELECTRIC CONDUCTIVITY OF METALS. I. ELECTRIC CONDUCTIVITY FOR LONGITUDINAL ELECTRIC FIELD. Takeo Izuyama (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 25: 964-80(June 1961). (In English)

A systematic diagram representation in a composite 4-dimensional space is developed for Kubo's response function which describes the electric response currents of metals for longitudinal electric fields. Proper diagrams are defined as the Feynman type linked diagrams which cannot be decomposed into simpler diagrams connected only by one Coulomb line. The greatest care is exercised with reference to the fact that Kubo's formula for the conduction phenomena gives the transport coefficient $\chi(q,\omega)$ defined as the ratio of the electric current vector to the electric displacement vector $D(q,\omega)$, while the electric conductivity $\sigma(q,\omega)$ of a metal is defined as the electric current vector divided by the electric field vector $E(q,\omega)$ in the metal. Thus $\sigma(q,\omega)$ is written as the product of $\chi(q,\omega)$ and the dielectric constant of the metal. It is shown that, the product is reduced to a simple form. In the reduced form, $\sigma(q,\omega)$ is expressed as the sum of the proper diagrams. In this expression the lowest order term in respect to the Coulomb interaction includes the usual sum on ring diagrams and, moreover, constitutes a much better approximation than the ring approximation. (auth)

28232 ON THE GREEN FUNCTION OF THE SPIN SYSTEM. [PART] I. Kyozi Kawasaki and Hazime Mori (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 1043-5(June 1961). (In English)

The two-time Green function method was used to calculate the spatial correlation of spins in a ferromagnet in the lowest order approximation. (L.N.N.)

28233 ON THE GREEN FUNCTION OF THE SPIN SYSTEM. [PART] II. Kyozi Kawasaki and Hazime Mori (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 1045-7 (June 1961). (In English)

The Green function method of Bogolyubov and Tyablikov was used to calcualte the spatial correlation of spins in a ferromagnet in the lowest order approximation for spin of an arbitrary magnitude. The case with spin =1 is described. (L.N.N.)

28234 EXPANSION OF THE LINEAR BOLTZMANN OPERATOR. Armand Siegel (Boston Univ.). Progr.

Theoret. Phys. (Kyoto), 25: 1049-51(June 1961). (In English)

The Boltzmann linear operator is expanded such that the successive terms in the expansion may be readily interpreted as corresponding to successive kinetic-theoretical corrections. Applications to noise spectra are given. (L.N.N.)

28235 NOTE ON THE INTEGRAL REPRESENTATION OF ABSORPTIVE PART OF VERTEX FUNCTION. Kunio Yamamoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 25: 1056-7(June 1961). (In English)

A correction to a previous paper stating that the absorptive part $A(Z_1,Z_2,\sigma^2)$ of the vertex function $F(Z_1,Z_2,Z_3)$ is of the form $A(Z_1,Z_2,\sigma^2) = \int d^3m\varphi\ (\sigma,m_1,m_2,m_3)\ XA^P(Z_1,Z_2,\sigma^2, m_1,m_2,m_3)$ where A^P is that of the lowest order perturbation theory and m_i is the virtual particle mass, is made. The conjecture that Jost's example did not have integral representation and contradicted local commutativity, is shown to be false, and corrective steps are taken. (L.N.N.)

28236 THE THEORY OF WAVE GUIDES LOADED WITH DIELECTRIC DISCS. N. A. Khizhnyak (Inst. of Physics and Tech., Academy of Sciences, USSR). Radiotekh. i Elektron., 5: 413-21(Mar. 1960). (In Russian)

Expressions are derived for the high-frequency flux in a waveguide loaded with dielectric, arbitrary thickness discs. It is shown that the efficiency of the waveguide is not disturbed. A dispersion equation is developed for the waveguide with a central beam opening, and approximation expressions are found for the aperture fields considering all harmonics for small radius openings. (tr-auth)

28237 PLASMA SYNTHESIS AND ITS APPLICATION TO THERMIONIC POWER CONVERSION. Karl G. Hernqvist (RCA Labs., Princeton, N. J.). RCA Rev., 22: 7-20 (Mar. 1961).

Thermionic energy converters (T.E.C.) in which the electron space charge is neutralized by positive-ion injection into the interelectrode space, are described. A method of representing the potential energy diagram for the plasma is described facilitating understanding of the interaction between plasmas and solids. Based on this model, a detailed plasma energy balance for different types of cathode materials is given. Results of a theoretical analysis of the space-charge problem in a cesium plasma type T.E.C. are described. The cases studied were for the two simplest space-charge states corresponding to a single potential maximum or a single potential minimum with an arbitrary applied potential between the electrodes. The different space-charge states that are possible when ions and electrons are injected into the interelectrode space are discussed. Experimental studies of plasma synthesis are described in which ions and electrons originate at different sources. The experimental tube operating as an energy converter had a power output of about 0.55 w/cm^2 a^1 a cathode temperature of 1100°C. (auth)

28238 DIRECT CONVERSION OF HEAT TO ELECTROMAGNETIC ENERGY. Fred M. Johnson (RCA Labs., Princeton, N. J.). RCA Rev., 22: 21-8(Mar. 1961).

Conversion of heat into electromagnetic energy is achieved by utilizing the intrinsically unstable space-charge properties of a thermionic cesium plasma diode. Experimental studies of this phenomenon are described. A physical model for the observed relaxation oscillations is proposed which is in qualitative agreement with experiments. (auth)

28239 SEMICONDUCTING MATERIALS FOR THERMOELECTRIC POWER GENERATION. F. D. Rosi, E. F. Hockings, and N. E. Lindenblad (RCA Labs., Princeton, N. J.). RCA Rev., 22: 82-121(Mar. 1961).

Thermoelectric properties of semiconductors suggest that (1) this class of materials can be useful in power-generating thermocouples operating at least up to 700°C, and (2) use of a sandwich-type arrangement or graded alloying in the construction of thermocouple branches will be necessary to achieve high figures of merit over a wide temperature range and, hence, high power-generating efficiencies. Ternary compound semiconductors having the cubic structure were synthesized. Those with the rock-salt structure, such as $AgSbTe_2$, are characterized by low lattice thermal conductivities (<0.0075 watt cm^{-1} deg^{-1}). The lattice thermal conductivity as a function of composition was examined in the alloy systems of $AgSbTe_2$ with PbTe, SnTe, and GeTe. The minimum in the lattice thermal conductivity for the $AgSbTe_2$ – PbTe system gives an effective mean free path for phonons which is less than unit-cell dimensions. Measurements of the temperature dependence of thermoelectric properties of a number of solid-solution alloy systems showed that (1) solid-solution alloys of Bi_2Te_3, with Bi_2Se_3, Sb_2Te_3, and Sb_2Se_3 provided the best p- and n-type material for thermocouple operation at 25 to 250°C, (2) the ternary compound $AgSbTe_2$ and its alloys with GeTe provided the best p-type material at 250 to 550°C, and (3) alloys in the PbTe–SnTe system provided the best n-type material at 250 to 550°C. Power-generating thermocouples, constructed in the sandwich-type arrangement of materials, provided an efficiency of ~12 per cent for operation at 20 to 550°C (i.e., $T_H - T_C = 530°C$). Continuous thermocouple operation for 300 hours resulted in no significant deterioration of material properties. (auth)

28240 NOISE SMOOTHING BY REACTIVE DAMPING IN FINITE MULTIVELOCITY ELECTRON BEAMS. J. Berghammer (RCA Labs., Princeton, N. J.). RCA Rev., 22: 185-94(Mar. 1961).

The dispersion relation for a finite-diameter multivelocity beam having a rectangular distribution of electron velocities is derived. It is found that in addition to the usual Hahn-Ramo waves, a pair of reactively damped waves can exist. The significance of these waves for noise-smoothing in long low-velocity beams of finite geometry is discussed. (auth)

28241 SOME PROBLEMS IN RELATIVISTIC GASODYNAMICS OF CHARGED PARTICLES. V. N. Tsytovich (Lebedev Inst. of Physics, [Moscow]). Zhur. Eksptl'. i Teoret. Fiz., 40: 1325-32(May 1961). (In Russian)

Some general problems in relativistic gasodynamics of charged particles in external and self-consistent fields are considered. An analog of potential motion is found and the theorem of conservation of magnetic flux along a liquid contour is generalized. The one-dimensional problem of break-up of a charged layer in external fields is solved. (auth)

28242 ON THE MOMENTUM DISTRIBUTION FUNCTION OF A FERMI-PARTICLE GAS IN THE HIGH DENSITY LIMIT. I. O. Kulik (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1343-52(May 1961). (In Russian)

A gas consisting of Fermi particles interacting according to Coulomb's law is investigated at 0° temperature by field theory methods. The interaction lines and propagation lines of free particles are renormalized; this permits one to take into account correlation and exchange effects of the interaction. The momentum distribution of the particles ($T = 0$) is calculated in the high density approximation (Gell-Mann–Brueckner approximation). The applicability of the high

density approximation for describing electron interaction in metals is discussed. (auth)

28243 ON THE ASYMPTOTIC FORM OF THE VERTEX PART IN ELECTRODYNAMICS. V. G. Vaks. Zhur. Eksptl'. i Teoret. Fiz., 40: 1366-8(May 1961). (In Russian)

28244 NORMALIZATION OF THE WAVE FUNCTIONS OF QUASISTATIONARY STATES. A. M. Dykhne and A. V. Chaplik (Inst. of Radiophysics and Electronics, Siberian Branch, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1427-8(May 1961). (In Russian)

A method for determining the norm of quasistationary states is presented which is not dependent on the assumption of spherical symmetry of the potential and is simpler than that proposed by Ya. B Zeldovich. (Zh. Eksp. i Teoret. Fiz., 39: 776, 1960). (auth)

28245 STABILITY OF MAGNETIC TANGENTIAL DISCONTINUITIES IN RELATIVISTIC HYDRODYNAMICS. M. T. Zhumartbaev (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1434-9(May 1961). (In Russian)

Small perturbations of the discontinuity surface in relativistic magnetohydrodynamics are examined. It is shown that in the case of small perturbations the magnetic tangential discontinuity is retained as such. Stability of magnetic tangential discontinuities is investigated. In particular, their instability region is determined in the ultrarelativistic case. (auth)

28246 CONTRIBUTION TO THE THEORY OF SUPERFLUIDITY IN AN IMPERFECT FERMI GAS. L. P. Gor'kov and T. K. Melik-Barkhudarov (Inst. of Problems in Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1452-8(May 1961). (In Russian)

The Cooper effect is studied in a low density Fermi gas. The transition temperature to the superfluid state is determined. (auth)

28247 NATURE OF THE AMPLITUDE SINGULARITIES IN QUANTUM FIELD THEORY. A. P. Rudik. Zhur. Eksptl', i Teoret. Fiz., 40: 1473-5(May 1961). (In Russian)

Restrictions on the singularities of quantum field theory amplitudes are derived by perturbation theory methods. (tr-auth)

28248 CHANGE IN THE MOMENTA OF CHARGES COLLIDING IN A MAGNETIC FIELD. Yu. N. Barabanenkov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1476-80(May 1961). (In Russian)

Scattering of two charged particles in a homogeneous and time-independent magnetic field is examined under the assumption of weak Coulomb interaction. The change in the particle momenta in scattering is calculated. It is shown that for two like charges the momentum change decreases according to an exponential law with increase of the impact parameter. Because of Larmor resonance the momentum change of oppositely charged particles decreases according to a power law with increase of the impact parameter. The magnetic field screens the interaction between the particles during scattering. A graphic interpretation of the magnetic field effect is expressed by spherically summetric potentials. In the case of like charges the potentials are of the Debye type, with opposite charges they are of the power type. (auth)

28249 ON RELATIVISTIC PERTURBATION THEORY FOR A COULOMB FIELD. V. G. Gorshkov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1481-90(May 1961). (In Russian)

Summation of the relativistic perturbation theory series for a Coulomb field is performed. The relativistic perturbation theory series is represented in the form of a new series, each term of which can be expressed linearly through an infinite nonrelativistic series. An integral equation defining the terms of this series is determined. All infrared divergences are collected together in a phase shift factor. (auth)

28250 ELECTRON TERMS IN THE FIELD OF TWO DIFFERENT COULOMB CENTERS. S. S. Gershtein and V. D. Krivchenkov (Inst. of Radiophysics and Electronics, Siberian Branch, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1491-1502(May 1961). (In Russian)

It is demonstrated that the Neuman–Wigner theorem on the impossibility of intersection of terms of the same symmetry is not valid for electrons in the field of two Coulomb centers. Terms for large and small distances between nuclei are compared for the case when the nuclear charges are different. It is indicated that term intersections exist which are important for charge exchange processes during collisions between hydrogen atoms and nuclei. (auth)

28251 SECONDARY ION EMISSION FROM METALS UNDER THE ACTION OF IONS POSSESSING ENERGIES BETWEEN 10 AND 100 kev. B. V. Panin. Zhur. Eksptl'. i Teoret. Fiz., 41: 3-10(July 1961). (In Russian)

Secondary ion emission from Mo, Zr, and graphite under the action of p, d^+, t^+; He^+, C^+, N^+, Cl^+, Ar^+, and Mo^+ ions was studied with the purpose of elucidating the mechanism of interaction at 10 to 100 kev atomic particles and solid bodies. The dependences of the ion-ion emission coefficients on the nature of the primary ions, their initial velocities and initial charge are studied. (auth)

28252 ELECTRON LOSS AND CAPTURE BY 200-1500 kev HELIUM IONS IN VARIOUS GASES. L. I. Pivovar, V. M. Tabaev, and M. T. Novikov (Khar'hov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 26-31(July 1961). (In Russian)

The effective cross sections for electron loss σ_{12} and electron capture σ_{10} by singly charged helium ions in single collisions in gases have been measured. The relative amounts of He^0, He^+, and He^{2+} ions in beams of equilibrium composition traversing the gases have also been measured. The cross section for electron capture by doubly charged helium ions σ_{21} and the cross section for electron loss by helium atoms σ_{01} are estimated from the relations of these components. The gas targets employed were hydrogen, helium, nitrogen, argon, and krypton. The measurements are performed for ion energies between 200 and 1500 kev. (auth)

28253 CAPTURE OF SEVERAL ELECTRONS BY FAST MULTICHARGED IONS. V. S. Nikolaev, L. N. Fateeva, I. S. Dmitriev, and Ya. A. Teplova (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 89-99(July 1961). (In Russian)

The cross section for capture of two or more electrons by multicharged ions of light elements in helium, nitrogen, argon, and krypton are measured for velocities from 2.6×10^8 to 12×10^8 cm/sec. In most cases the probability for electron capture is determined by the magnitude of the ionization potential of the produced ion and weakly depends on the number of captured electrons. It is shown that the simultaneous capture of several electrons in a particle beam with an equilibrium charge distribution is the chief mode of formation of low charge ions. (auth)

28254 ON ROTATION OF THE PLANE OF POLARIZATION OF LIGHT IN THE CASE OF NONCONSERVATION OF PARITY. A. M. Perelomov. Zhur. Eksptl'. i Teoret. Fiz., 41: 183-5(July 1961). (In Russian)

Rotation of the plane of polarization of light by a system is considered by taking into account interactions which do not conserve parity. A concrete calculation is carried out for the hydrogen atom. (auth)

28255 REFLECTION OF ELECTROMAGNETIC WAVES IN GYROTROPIC MEDIA FROM A MAGNETIC FIELD WAVE. G. I. Freidman (Gor'kii State Univ., [USSR]). Zhur. Ekstpl'. i Teoret. Fiz., 41: 226-32(July 1961). (In Russian)

Reflection of electromagnetic waves in a ferrite or in an infinite homogeneous plasma from the wave of a magnetic field (moving magnetic mirror) and also reflection from a moving plasma and from an ionization wave produced in a stationary plasma are considered. The calculations are performed in the geometrical optics approximation. A more exact solution has been found in the neighborhood of the point at which the approximation becomes invalid. It is shown that in all cases considered the frequency increases upon reflection. The wave amplitude and total energy of the wave packet also increase after reflection; an exception is reflection from an ionization wave for which the amplitude of the reflected wave is equal to the amplitude of the incident wave and the total energy of the wave packet decreases upon reflection. (auth)

28256 DISINTEGRATION OF NONEVOLUTIONAL SHOCK WAVES. R. V. Polovin and K. P. Cherkasova (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 263-6(July 1961). (In Russian)

Disintegration of a magnetohydrodynamic shock wave with a small density discontinuity is investigated. The initial shock wave is a compression wave for which all boundary conditions are satisfied and entropy increases. If the initial shock wave is an evolutional one it cannot disintegrate. A nonevolutional shock wave can disintegrate into six magnetohydrodynamic waves (which are discontinuous or centered simple waves, depending on the magnitude and direction of the initial magnetic field. (auth)

28257 ON THE PLASMA FLUX MOTION IN A TUBE IN THE PRESENCE OF EXTERNAL CROSSED ELECTRIC AND MAGNETIC FIELDS. V. M. Sarychev. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 1, 3-9(Janl-Feb. 1961). (In Russian)

The elementary theory of plasma is applied in an analysis of the motion of partially ionized gas in a tube in the presence of crossed electric and magnetic fields. The drift velocity, charged particle temperature and energy dissipation are found, and the maximum conditions of volume force effects and specific power input are determined. (R.V.J.)

28258 SHOCK WAVES REFLECTION AND REFRACTION IN MAGNETOHYDRODYNAMICS. S. E. Grebenshchikov, M. D. Raizer, A. A. Rukhadze, and A. G. Frank (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz., 31: 529-38(May 1961). (In Russian)

Experiments were made on annular, converging shock wave reflection and refraction on a magnetic wall. The developed ratios between the velocities of incidence and reflected and refracted shock waves are in good agreement with theoretical calculations. (tr-auth)

28259 INSTABILITY OF TWO-BEAM SYSTEM IN MAGNETIC FIELD. B. N. Rutkevich (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 31: 539-48(May 1961). (In Russian)

Transverse motion of two electron beams losing stability due to transverse oscillations related to cyclotron rotation in a magnetic field are studied. Hollow coaxial beams in which the electron layer is a simple surface with a normal electric field component undergoing rupture equal to $4\pi\delta$, where δ is the surface charge density, were used. It is assumed that the wave phase rate v_{phase} is small in comparison to light, therefore, the magnitudes of v_{light}^{phase} are not considered. (R.V.J.)

28260 PLASMA ELECTRON OSCILLATIONS BETWEEN TWO ELECTRODES. S. V. Iordanskii (Steklov Mathematical Inst., Moscow). Zhur. Tekh. Fiz., 31: 549-56(May 1961). (In Russian)

The stability of electron plasma confined between two plane infinite electrodes during the passage of an electron beam through one of the electrodes is analyzed. The problem is set up as a hydrodynamic approximation of "cold plasma" in which the electron beam velocity is larger than the thermal velocity of the electron beam and plasma and the characteristic dimensions are large compared to the Debye radius. The basic equation is written in the form of one-dimensional oscillations. The results are in good agreement with published data. (R.V.J.)

28261 ELECTRICAL FIELD OF EMITTER SITUATED WITHIN PLASMA WITH OUTER MAGNETIC FIELD. B. P. Kononov, A. A. Rukhadze, and G. V. Solodukhov (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz., 31: 565-73 (May 1961). (In Russian)

Theoretical and experimental investigations were made of electric field behavior in the closest emitter zone in magnetically confined plasma. The measurements were made with two antennas and a single high-frequency probe. Electric field behavior can be utilized for measuring electron concentration and magnetic field intensity in the plasma. (tr-auth)

28262 NON-LINEAR EFFECTS IN PROPAGATION OF ELECTROMAGNETIC WAVES THROUGH PLASMA WAVEGUIDE. O. G. Zagorodnov, Ya. B. Fainberg, B. I. Ivanov, V. S. Us, and L. I. Bolotin (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 31: 574-6(May 1961). (In Russian)

Experimental studies were made of the non-linear distortions in sinusoidal electromagnetic wave propagation in a cylindrical plasma waveguide. Non-linearity was studied with a special device in the plasma column formed by a d-c discharge in mercury vapor. The electromagnetic sinusoidal wave is excited and received by short spirals fitted on the discharge tube. Signals from the waveguide entrance and exit are indicated on a two-beam oscillograph. The spectral composition was studied with amplitude analyzer and graphically. The results are plotted. (R.V.J.)

28263 THE MOTION OF CHARGED PARTICLE IN A SPECIAL STATICAL ELECTROMAGNETIC FIELD. A. S. Borodkin. Zhur. Tekh. Fiz., 31: 582-7(May 1961). (In Russian)

The equations of point charge propagation in static electric and magnetic fields are resolved as elementary functions or quadratures. Cases of electron propagation in a homogeneous magnetic field, superimposed on a cylindrical condenser field with a parallel axis and superimposed in the same way on a hyperbolic condenser field, have been resolved previously. Other cases of combined static electric and magnetic fields with certain charge motions can be applied in describing high-vacuum discharge in a magnetic field. In such cases the equation of motion is reduced to quadratures, and the previously resolved equations of motion may be analyzed as specific cases. (R.V.J.)

28264 ON THE KINETIC THEORY OF A LOW PRESSURE PLASMA THERMOELEMENT. M. I. Kaganov,

R. Ya. Kucherov, and L. E. Rikenglaz. Zhur. Tekh. Fiz., 31: 588-96(May 1961). (In Russian)

The kinetic theory of plasma thermoelements is analyzed with the assumptions that the lengths of free electron and ion paths are considerably larger than the dimensions of the apparatus and that the potential in the space between the anode and cathode varies monotonously. (tr-auth)

28265 FORMATION OF NEGATIVE HYDROGEN IONS BY PASSING PROTONS THROUGH GASEOUS TARGETS. Yu. M. Khirnyi. Zhur. Tekh. Fiz., 31: 597-605(May 1961). (In Russian)

The contents of H_1^-, H_1^+, and H_1^0 in beams developed during proton passage through H_2, He, Ne, Ar, CO_2, and C_3H_8 targets were found, and data on hydrogen beam scattering on these targets are given. (tr-auth)

28266 THE SOLUTION OF STATIONARY EQUATION FOR UNIDIMENSIONAL MOTION OF A COMPRESSIBLE FINITE CONDUCTIVITY GAS IN TRANSVERSE ELECTRICAL AND MAGNETIC FIELDS. K. A. Lur'e (Ioffe Inst. of Physics and Tech., Leningrad). Zhur. Tekh. Fiz., 31: 623-7(May 1961). (In Russian)

The solution for the stationary problem in the presence of an electric field is developed with finite formulas containing elliptic functions. In the examined problem $v = (v_1, 0, 0)$, $E = (0, E, 0)$, and $H = (0, 0, H_1)$ are known and E = const. The problem does not consider heat-transfer, viscosity, and heat conductivity. In the integration the conductivity σ is assumed constant. (R.V.J.)

28267 EXPERIMENTAL RESEARCH ON THE CESIUM THERMIONIC CONVERTER. N. S. Rasor (Atomics International, Canoga Park, Calif.). Presented at the IAS 29th Annual Meeting, New York, New York, January 23–25, 1961. IAS Paper No. 61-72. New York, Institute of The Aerospace Sciences, 1961. 16p. $1.00.

Due to the complex nature of the energy conversion process in the cesium vapor thermionic converter, theoretical investigations and preliminary system analysis must rely heavily on experimentally observed converter behavior. Phenomena observed in a variety of converters are described which give insight into the basic processes occurring, and which are significant in thermionic system design and analysis. Emphasis is given to comparing this observed behavior with the natural limits imposed by elementary thermionic emission processes. Approaches being taken to suppress non-essential departures from these limits are described. (auth)

28268 THE FERMI SURFACE. Proceedings of an International Conference held at Cooperstown, New York on August 22-24, 1960. W. A. Harrison and M. B. Webb, eds. New York, John Wiley & Sons, Inc., 1960. 368p.

The Fermi surface is discussed from both the theoretical and experimental points of view. A summary of recent progress in understanding electronic properties of metals is made. The importance of many-body effects in both theory and experiment, the diverse experimental and theoretical information on the noble metals, progress in the understanding of polyvalent metals, and the electronic structure of alloys are given special prominence. Separate abstracts have been prepared for 32 papers of this symposium. (L.N.N.)

28269 THEORY OF THE FERMI SURFACE. J. M. Luttinger (Columbia Univ., New York). p.2-8 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

A discussion of the present state of the theory of the Fermi surface for a system of interacting fermions is given. A listing of the specific results obtained by perturbation theory to arbitrary order is made, and a very brief indication of the essential theoretical tools (the theory of propagators) is presented. (auth)

28270 BAND CALCULATIONS OF THE SHAPE OF THE FERMI SURFACE IN THE ALKALI METALS. Frank S. Ham (General Electric Research Lab., Schenectady, N. Y.). p.9-27 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

A series of calculations of the energy bands of the alkali metals has been carried out with the use of the Green's function method and the quantum defect method. Results relating to the shape of the Fermi surface are reported. The gap $(N_s - N_p)$ at the (110) zone face is found to be +.225, +.019, −.037, −.064, −.096 (in Rydbergs) for Li, Na, K, Rb, and Cs, respectively. Accordingly, the Fermi surface is most distorted from a sphere in Li and Cs and very little distorted for Na and K, in agreement with Cohen and Heine's prediction and their interpretation of available experimental data. These data are reviewed in the light of Bailyn's conclusions concerning the importance of Umklapp processes in transport calculations and the likelihood that other effects influence the data as strongly as do distortions of the Fermi surface. It is concluded that it is not now possible to deduce the Fermi surface shape of the alkalies with any certainty from available experimental results. The Green's function method is compared with other cellular methods of calculation and found to be much more useful in giving rapid convergence and in avoiding a difficulty from which other cellular methods have suffered concerning the representation of the wave function in the cell corners. A simplified theory of band shapes due to Cohen and Heine is found to describe the position of N_s quite well, provided that the wave function does not have a large d component. Their theory does not describe N_p accurately, nor is the variation of band gap with lattice constant given correctly. The present results on the alkalies can be fitted by an interpolation formula derived by mixing nearly degenerate plane waves through a weak pseudopotential only if the latter is made l-dependent. While this dependence may be expected on general grounds, it introduces too many parameters to permit a simple description of the bands. (auth)

28271 ELECTRONIC STRUCTURE FROM THE ONE-OPW, OR NEARLY-FREE-ELECTRON, POINT OF VIEW. Walter A. Harrison (General Electric Research Lab., Schenectady, N. Y.). p.28-38 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

The nature of this point of view is described in physical terms, and some discussion of the extent of its validity is made. Several electronic properties are surveyed, and, utilizing this picture of the band structure, a study is made of the extent to which aspects of the electronic behavior other than the geometry of the Fermi surface are important in determining these properties. It is noted that though the usual one-electron point of view may well yield a description of the geometry of the Fermi surface, more complicated effects must certainly be included in an understanding of properties related to an effective mass. The contribution to the total energy of the electron systems due to "Brillouin-zone overlaps" is estimated and found to be negligible, at least in aluminum, with respect to properties such as the elastic constants. Some discussion is made of the properties of alloys and in particular of the "rigid-band model", and the determination of Fermi surfaces in ordered alloys is illustrated. Finally, the behavior of simple electronic systems in crossed electric and magnetic fields is discussed. (auth)

28272 THE VELOCITY AND EFFECTIVE CHARGE OF THE PARTICLES NEAR THE FERMI SURFACE. L. M.

Falicov (Cavendish Lab., Cambridge, Eng.). p.39-49 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

The transport properties of a metal, taking account of the electron-electron interaction, can be explained in terms of elementary excitations of the electron gas. These excitations or quasi-particles, electron-like or hole-like, can be defined in k-space only near the Fermi surface and they behave nearly independently of each other. Considering the case of only one quasi-particle, it is shown that its velocity is still given by the relation $v_k = (1/\hbar)\ \mathrm{grad}_k \epsilon(k)$, where $\epsilon(k)$ is the single quasi-particle energy; however, the charge carried by the excitation is no longer e, the electronic "bare" charge, but an effective charge e_k^*, smaller than e. For the free electron case it is proved that $e_k^* = (e\hbar/m)\ (|k|/|v_k|)$ and therefore the contribution to the current due to one quasi-particle is equal to the current carried by a free non-interacting electron which has the same k-vector. Using the Bohm and Pines values for the single particle energies, $e_k^*/e \cong 0.9$. In all the formulas concerning transport properties based on the independent particle model, the electronic charge e must be replaced by e_k^*, which give rise to an appreciable correction. This can be important in evaluating the geometrical properties of the Fermi surface obtained from experimental data. (auth)

28273 ELECTRON-PHONON INTERACTION IN NORMAL METALS. John J. Quinn (R. C. A. Labs., Princeton, N. J.). p.58-66 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

An electron self-energy approach is used to study the effect of the electron-phonon interaction on the low temperature electronic properties of normal metals. The self-energy of a single additional electron, due to virtual emission and reabsorption of phonons, is calculated by perturbation theory along lines already laid out by Fröhlich. The self-energy and its derivative with respect to momentum are evaluated at the Fermi surface. Although the former gives a negligible contribution to the single-particle energy, the latter is found to considerably enhance the density of states. A rough estimate indicates that "umklapp" as well as normal processes are of importance in the self-energy calculation. The enhanced density of states should be manifest in measurements of the low temperature electron specific heat and cyclotron resonance. In contrast to these, it is shown that the magnetic spin susceptibility is unaffected by the electron-phonon interaction, at least to this order of perturbation theory. This last result is shown to be independent of the exact form of the matrix element for phonon emission, and is valid whether or not "umklapp" processes are included. (auth)

28274 THE DE HAAS-VAN ALPHEN EFFECT. D. Shoenberg (Royal Society Mond Lab., Cambridge, Eng.). p.74-83 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

The use of the de Haas-van Alphen effect as a tool for determination of the Fermi Surface is reviewed with special reference to recent work on copper, silver, and gold and to a number of polyvalent metals. (auth)

28275 LOW FIELD DE HAAS-VAN ALPHEN STUDIES OF THE FERMI SURFACE OF MAGNESIUM. W. L. Gordon, A. S. Joseph, and T. G. Eck (Case Inst. of Tech., Cleveland). p.84-7 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

A null deflection torsion method permitting automatic recording of torque as a function of 1/H was employed to study the de Haas-van Alphen oscillations in the magnetic susceptibility of single crystals of magnesium in fields up to 18 kgauss and at temperatures of 4.2°K and below. Analysis of the angular dependence of the de Haas-van Alphen periods on field orientation relative to crystalline axes yielded extremal cross sections of the Fermi surface which agreed closely with portions of the free electron construction proposed by W. A. Harrison. Although neither the 0002 nor $10\bar{1}1$ face overlaps were observed, this merely indicated a lower limit to their minimum cross section of approximately 0.12 A^{-2} imposed by the sensitivity of the apparatus. (auth)

28276 MAGNETOTHERMAL OSCILLATIONS AND THE FERMI SURFACE. J. E. Kunzler and F. S. L. Hsu (Bell Telephone Labs., Inc., Murray Hill, N. J.). p.88-96 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

Magnetothermal oscillations show up experimentally as a reversible and cyclic variation of the temperature of a thermally isolated single crystal, such as bismuth, as the magnitude or the orientation of an applied magnetic field is changed in a uniform manner. The oscillatory temperature changes are periodic in 1/H and their variation with orientation is dependent on the detailed shape of the pertinent part of the Fermi surface in much the same manner as magnetic susceptibility oscillations. Susceptibility oscillations depend on the variation in the free energy while the magnetothermal oscillations involve only entropy changes and are thus a direct measure of the variations in the density of electronic states at the Fermi surface. Of the oscillatory effects used for the study of Fermi surface shapes at moderate magnetic fields, magnetothermal oscillations appear to have yielded the best resolution. When in addition one considers the facility with which these observations can be made, studies of the Fermi surface by this method are very attractive. Brief descriptions of the method have been given recently. The higher resolution obtained with magnetothermal oscillations made it possible to observe the spin splitting of the Landau levels in bismuth. The resolution of such splitting by other de Haas-van Alphen type observations has not been reported. (auth)

28277 MAGNETORESISTANCE. R. G. Chambers (Univ. of Bristol, Eng.). p.100-24 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

After a brief review of the properties of spherical, ellipsoidal, and cylindrical energy surfaces, the general magnetoresistance problem is discussed for the low-field, intermediate-field, and high-field regions in turn. The Jones-Zener solution for low fields can give some information about the Fermi surface, but only if some assumption is made about the anisotropy of relaxation time. At intermediate fields, where the transport equation cannot be solved by series expansion in either $\omega\tau$ or $(\omega\tau)^{-1}$, the variational method is particularly useful, and with this approach it may also be possible to separate out Fermi surface anisotropy from relaxation time anisotropy. At high fields, as Lifshitz and Peschanskii have shown, the magnetoresistance behavior is largely determined by the presence or absence of open electron orbits, and a discussion is given of Fermi surface topologies and types of electron orbit. The theory of high-field behavior is then outlined, and the results of Alekseevskii and Gaidukov discussed. The paper concludes with a brief survey of recent work on the theory of oscillatory magnetoresistance in the quantum region. (auth)

28278 HIGHER ORDER OPEN ORBITS AND THE INTERPRETATION OF MAGNETORESISTANCE AND HALL EFFECT DATA FOR COPPER. J. R. Klauder and J. E. Kunzler (Bell Telephone Labs., Murray Hill, N. J.).

p.125-33 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

Magnetoresistance and Hall effect measurements were made in copper crystals. Anisotropic magnetoresistance behavior was explained by a Fermi surface intersecting the Brillouin zone boundary only on the <111> faces. Additional sets of magnetic field orientations where ($\Delta R/R$) does not saturate but is reduced by 10 to 100 relative to H^2 data were observed. The measured high field Hall constant for several orientations was compared with numerical predictions derived from the Pippard-Fermi surface shape. Reasonable agreement was obtained but would be improved by increasing the diameters of the "necks" of the Pippard-Fermi surface. (L.N.N.)

28279 ANISOTROPY OF GALVANOMAGNETIC TENSORS OF SEMIMETALS WITH PARTICULAR ATTENTION TO BISMUTH. Shoichi Mase (Nagoya Univ., Japan). p.134-40 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

A theory of the galvanomagnetic effect of semimetals with several ellipsoidal bands is presented. The principal object is an analysis of the relation between the energy bands and the anisotropy of the galvanomagnetic tensor of bismuth crystals which show extreme anomalies in various physical properties. We limit the applicability of the theory to the range of low energy phonon scattering which is predominant; i.e. to moderately low temperatures, from experimental and theoretical points of view. With the assumptions of a classical distribution and the Debye approximation for phonons, we obtain nearly isotropic scattering below the quantum limit, irrespective of any anisotropy of the energy bands. If our fundamental assumption of the effective-mass approximation is valid, we can determine the shapes of the Fermi surfaces of semimetals by comparing our theoretical expression for the anisotropic galvanomagnetic tensor with arbitrary direction of magnetic field with experiments. Because of scanty data from satisfactory experiments, we give only the predicted curves of the galvanomagnetic tensor of bismuth versus the magnetic field, using the effective masses from cyclotron absorption experiment instead of determining the energy band shape. (auth)

28280 CYCLOTRON RESONANCE IN METALS—EXPERIMENTAL. A. F. Kip (Univ. of California, Berkeley). p.146-53 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

Azbel'-Kaner type cyclotron resonance experiments give information on effective masses of electrons in tin, lead, aluminum, bismuth, and copper. The most detailed studies are in copper and are used to illustrate the importance of several experimental parameters in identifying various types of orbits. These parameters include tipping of the magnetic field at small angles relative to the metal surface, and adjustment of the r.f. electric field either parallel or perpendicular to the magnetic field. Phase shift of the cyclotron harmonics are discussed. New data on copper include values for the cyclotron mass of the belly orbit, the dog's bone orbit, a double mass orbit, and an orbit which is tentatively identified as the neck orbit. Results are consistent with the general shape of the Pippard model for the Fermi surface in copper. (auth)

28281 CYCLOTRON RESONANCE: THEORY. J. C. Phillips (Royal Society Mond Lab., Cambridge, Eng.). p.154-8 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

A brief review of the Azbel'-Kaner theory of cyclotron resonance in metals is given. Various corrections that have been proposed to their idealized model are discussed. Diamagnetic resonance effects in metals (with $\underline{H}$ normal to sample surface) are also reviewed. (auth)

28282 CYCLOTRON RESONANCE OBSERVATIONS IN ZINC. J. K. Galt and F. R. Merritt (Bell Telephone Labs., Murray Hill, N. J.). p.159-65 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

Observations of cyclotron resonance in zinc are extended to magnetic fields of 85 kg in certain directions. These and other observations are made on samples purer than those used in earlier work with the result that longer relaxation time for charge carriers and therefore better resolution of the signals is achieved. The results show: (1) the cyclotron mass for carriers which orbit around the hexagonal axis is about 1.3 m_0, somewhat higher than previously reported; (2) there are no carriers in zinc with masses substantially higher than these; (3) carriers of about this mass are observed with magnetic field along the [110] and [210] directions as well as the lower mass carriers previously reported. (auth)

28283 CYCLOTRON RESONANCE IN ALUMINUM. E. Fawcett (Royal Radar Establishment, Malvern, Eng.). p.166-9 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

Measurements of cyclotron resonance in aluminum at 35.5Gc/s in magnetic fields up to 30 kg have failed to confirm Langenberg and Moore's observation of resonance due to a carrier of effective mass ratio 1.5. A pronounced minimum of the resistance is observed at about 10 kg, over a wide range of orientations. In the absence of a further minimum at higher fields this is interpreted as the fundamental resonance of a carrier of mass ratio 0.87 ± 0.05, though the quality of the samples is too poor to show more than the first subharmonic. This value is in better agreement with the theoretical estimate for hole carriers in the second Brillouin zone obtained by Harrison. (auth)

28284 CYCLOTRON RESONANCE IN METALS AT HIGH FREQUENCIES. M. C. Jones and E. H. Sondheimer (Queen Mary Coll., London). p.170-73 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

The classical theory of longitudinal cyclotron resonance for an isotropic electron gas is formulated as a variational problem. A simple approximate solution is obtained, valid for $(l/\delta_0)^2 \ll (\omega\tau)^3$, $\omega\tau \gg 1$ (where l is the electron free path, τ the relaxation time, δ_0 the classical skin depth and ω the applied frequency), and for all values of the applied magnetic field. The surface resistance reduces to the value obtained by Holstein and Dingle when $\omega_c = 0$ (where ω_c is the cyclotron frequency) and to the "classical" value when $\omega_c = \infty$, and it oscillates in the usual way as a function of ω/ω_c. (auth)

28285 THE ANOMALOUS SKIN EFFECT. G. E. Smith (Bell Telephone Labs., Murray Hill, N. J.). p.182-96 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

Anomalies in the high-frequency resistance of metals at low temperatures were first noticed by H. London in 1940 and attributed to the mean free path, l, of conduction electrons being greater than the skin depth δ. This effect has become known as the anomalous skin effect, and the rise of microwave technology has fostered a fairly extensive study of the phenomenon. It was shown that in the extreme anomalous limit, $l \gg \delta$, the surface resistance R becomes independent of the relaxation time τ and is only a function of the size and shape of the Fermi surface. Because of this property, measurements of R were used by several workers to obtain information on features of the

Fermi surface. In the case of a suitably averaged R, such as in polycrystalline material, one obtains the total area of the Fermi surface, and measurements on single crystal material as a function of orientation yield information on its shape. Details of the effect are discussed and experimental results are reviewed with emphasis on its advantages and limitations as a tool for investigating Fermi surfaces in metals. (auth)

28286 ANOMALOUS SKIN EFFECT IN ALUMINUM. E. Fawcett (Royal Radar Establishment, Malvern, Eng.). p.197-202 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

The anisotropy of the surface conductance Σ of aluminum under anomalous skin effect conditions was measured. The results are compared with a model of the Fermi surface similar to one proposed by Harrison, which is obtained from the free-electron sphere by shearing it normal to the lines of intersection with the Brillouin zone faces so that in the third zone the surface coincides with the slightly smaller sphere intersecting the zone corners. The average value of Σ^3 is used to estimate the ratio S/S_0 of the total areas of the Fermi surface to the area S_0 of the free-electron sphere. Measurements of Σ for polycrystalline samples of magnesium, zinc, and cadmium are also quoted in this form, and the values of S/S_0 are combined with specific heat data to obtain the Fermi velocities in these metals. (auth)

28287 INTERBAND MAGNETOREFLECTION EXPERIMENTS IN BISMUTH. R. N. Brown, J. G. Mavroides, M. S. Dresselhaus, and B. Lax (Massachusetts Inst. of Tech., Lexington). p.203-9 of "The Fermi Surface." New York, John Willey & Sons, Inc., 1960.

Pulse experiments on Bi were interpreted on a more satisfactory basis as interband transitions between magnetic levels. Further evidence for this hypothesis was provided by magnetoreflection experiments with lower steady state fields and higher photon energies. Such experiments at liquid air temperatures and below were carried out, using magnetic fields up to 38.6 kilogauss and wavelengths between 6 and 14 μ. Results for the mass parameters of the conduction band are in agreement with those of other experiments, and for the effective g-factors in accordance with the theory of Cohen and Blount. This technique provides a powerful tool for exploring the energy band structure of metals not only at the Fermi surface and at liquid helium temperatures, as with other techniques but also at energies below and above the Fermi surface and at higher temperatures as well. The effective masses and also the effective spectroscopic splitting factors of the valence and conduction bands can be determined. (auth)

28288 THE FERMI SURFACES OF THE NOBLE METALS BY ULTRASONICS. R. W. Morse (Brown Univ., Providence). p.214-23 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

The shapes of the Fermi surfaces of copper, gold, and silver as revealed by ultrasonic attenuation measurements are reviewed. The experimental method employed is an oscillatory variation of attenuation with magnetic field. A variety of orbit types are found to contribute oscillatory components from which many of the characteristic dimensions of the Fermi surfaces can be calculated. It is found that all three noble metals make significant zone boundary contact in the [111] directions. For copper and gold the data give a direct measurement of the radius of the touching area, an estimate of the shape of the neck joining the zone boundary, as well as radii of the main body of the surface in several directions. (auth)

28289 THEORY OF ULTRASONIC ATTENUATION IN METALS. A. B. Pippard (Cavendish Lab., Cambridge, Eng.). p.224-32 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

The forces acting on an electron when an acoustic wave passes through a real metal are analyzed, and found to have their origin (apart from electromagnetic forces) in two separable effects—a deformation effect due to variations of the Fermi surface with strain, and a relative velocity effect arising when an electron travels between regions moving at different speeds. These effects may be simulated by fictitious forces acting on the electrons in an undeformed lattice, so that the response of the metal to the wave becomes a straightforward problem in conduction theory. Results are quoted and discussed briefly for a metal not subjected to a magnetic field, and for a metal in a transverse field when the free path is long enough to allow many revolutions of the cyclotron orbits. The factors determining the oscillatory magneto-acoustic effect are examined critically, and finally the influence of open orbits on the limiting attenuation in high magnetic fields is analyzed. (auth)

28290 MAGNETOACOUSTIC EFFECTS IN LEAD AND TIN. A. R. Mackintosh (Royal Society Mond Lab., Cambridge, Eng.). p.233-6 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

The results of a detailed study of transverse magnetoacoustic effects in lead are presented, and a form of Fermi surface suggested on the basis of this and previous experimental work. Measurements on ultrasonic attenuation in tin in longitudinal magnetic fields are described, and some features of the Fermi surface of tin deduced from them. (auth)

28291 THE FERMI SURFACE IN TIN FROM ULTRASONIC ATTENUATION. Tore Olsen (Brown Univ., Providence and Universitetet i Oslo, Blindern, Norway). p.237-44 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

The magnetic field dependence of the ultrasonic attenuation was measured in very pure tin single crystals at low temperature where the electron mean free path is comparable to the acoustical wave length. The oscillatory variation of the attenuation when the field is perpendicular to the direction of sound propagation yields in a very direct way information about the Fermi surface. Some preliminary studies of these measurements have been presented earlier by Olsen (1960) and by Olsen and Morse (1959). Here the measurements will be treated in greater detail and re-examined in the light of the very successful "nearly-free-electron" approximation used by Gold (1958) on lead and by Harrison (1959) on aluminum both to study de Haas-van Alphen data. Both compressional waves and shear waves were propagated along four different directions in the crystals. The magnetic dependence of the attenuation and hence the Fermi momenta were found to be very anisotropic, but in general agreement with the Fermi surface suggested from the "nearly-free-electron" approximation. (auth)

28292 SOME FERMI SURFACE MEASUREMENTS IN SILVER. Henry V. Bohm (Wayne State (Univ., Detroit). p.245-50 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

Measurements at liquid helium temperatures using ultrasonic pulses of frequencies above 100 Mc/sec were made in a single crystal silver sample. The attenuation was examined as a function of magnetic field strength and direction. Results are compared with those of Morse et al.,

and Mielczarek et al. Some previously unreported Fermi momenta are given. Some shear wave data, the interpretation of which is not clear, are also presented. (auth)

28293 THE POSSIBLE RELATION BETWEEN THE SHAPE OF THE FERMI SURFACE AND THE MAGNETIC-FIELD ROTATION DIAGRAMS OF ULTRASONIC ATTENUATION. L. Mackinnon and M. T. Taylor (The University, Leeds, Eng.). p.251-7 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

The value of the electronic component of megacycle ultrasonic attenuation in pure metals can depend both on the magnitude and on the direction of an applied magnetic field. If the magnitude of the field is kept constant and if the field is rotated in a plane perpendicular to the propagation direction of the sound, then anisotropy may be seen in the absorption-field direction plot for both longitudinal and shear waves. On the free-electron model, this anisotropy would not be expected to occur for longitudinal waves and is usually not of the form that can be predicted for shear waves. Among the theoretical treatments of the absorption problem on the free-electron model (spherical Fermi surface) is that of Cohen, Harrison and Harrison. This treatment was extended first to an ellipsoidal Fermi surface and secondly to a Fermi surface consisting of a number of ellipsoids arranged with cubic symmetry. Preliminary calculations from this theory provide a qualitative picture of the anisotropy in the rotation diagrams. When, however, the field is rotated in the plane containing the propagation direction, experimental results on a lead specimen are obtained which in certain ways do not seem to correspond with any present theory, although they are probably related in some similar way to the shape of the Fermi surface. (auth)

28294 OPTICAL PROPERTIES OF METALS. J. A. Rayne (Westinghouse Electric Corp., Pittsburgh). p.266-78 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

The optical properties of metals and alloys can give useful information about their band structure. A survey of the various types of measurement is given and the results of recent experiments are discussed. (auth)

28295 ELECTRONIC BAND STRUCTURE IN ALLOYS AND LIQUID METALS. Volker Heine (Royal Society Mond Lab., Cambridge, Eng.). p.279-89 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

How the concept of electronic band structure can be applied to disordered alloys and liquid metals is discussed. Knight shift data on liquid binary mixtures of alkali metals are analyzed. It is concluded that each atom in the mixture sees a local spin susceptibility approximately equal to that in the corresponding pure metal. Present ideas about the band structure of the alpha phase alloys of the noble metals are reviewed, with particular reference to the size of the band gap, the electronic specific heat, and the Hume-Rothery rule. (auth)

28296 CHANGES OF LATTICE SPACINGS IN ALLOYS AND THE SHAPE OF THE FERMI SURFACE. T. B. Massalski and H. W. King (Mellon Inst., Pittsburgh). p.290-5 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

Studies of systematic lattice spacing changes with composition in face-centered cubic and hexagonal close packed alloys based on noble metals provide information which can be interpreted in terms of interactions of the Fermi Surface with the Brillouin zone. Recently obtained data on a large number of h.c.p. alloys show a striking dependence of such interactions on the electron concentration. The influence of the solute elements on lattice spacings in silver-based alloys may be interpreted qualitatively by considering that the band gaps of silver are modified by the additions of the solute elements. Such considerations enable tentative conclusions to be drawn regarding the nature of the band structure in pure silver. (auth)

28297 "ORDINARY" TRANSPORT PROPERTIES AND THE SHAPE OF THE FERMI SURFACE. J. M. Ziman (Univ. of Cambridge, Eng.). p.296-305 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

Information about the shape of the Fermi surface can be obtained from the ordinary transport properties. The electrical resistivity suggests that metals in the second row of the periodic table are nearest to the free electron model. The "phonon drag" contribution to the thermoelectric power in the monovalent metals can be explained by distortion of the Fermi surface. To understand the "diffusion" thermoelectric power and Hall coefficients of the noble metals, we must assume that the relaxation time of the electrons is much smaller at the zone boundaries than on the "belly" of the Fermi surface. (auth)

28298 A NOTE ON THE THERMOELECTRIC POWER OF MONOVALENT METALS. P. G. Klemens (Westinghouse Electric Corp., Pittsburgh). p.306-8 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

It is shown that the lattice component of the thermoelectric power of monovalent metals must be negative at lowest temperatures, irrespective of the location of the Fermi surface with respect to the zone boundary. (auth)

28299 THEORETICAL SUMMARY. M. H. Cohen (Hughes Research Lab., Malibu, Calif.). p.318-29 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

A definition of a Fermi surface is given, and several theories of approach are mentioned. Band structure calculations, simple models and their meanings, and the theory of experiments giving specific and detailed information about the Fermi surface are discussed. (L.N.N.)

28300 EXPERIMENTAL SUMMARY. A. B. Pippard (Cavendish Lab., Cambridge, Eng.). p.330-40 of "The Fermi Surface." New York, John Wiley & Sons, Inc., 1960.

The validity of the single particle or quasi-particle concept and whether or not the Fermi surface can be determined are discussed. Such questions as velocities of electrons at all points on the Fermi surface, the relaxation time, if any, for certain situations, and the effects of metal deformations are mentioned. The metals are divided into four groups, and various methods for use with each group are brought up. Oscillatory effects, their value in gaining information, and their sensitivities are also discussed. (L.N.N.)

28301 DISSERTATIONS IN PHYSICS. An Indexed Bibliography of All Doctoral Theses Accepted by American Universities, 1861–1959. M. Lois Marckworth, comp. Stanford, California, Stanford University Press, 1961. 812p. $17.50.

An indexed bibliography of all doctoral theses accepted by American universities, 1861 to 1959, is given. The theses are listed in alphabetical order by author. The information given under the author includes the title of the dissertation, university, degree granted, year granted, and the source from which a copy is most readily obtainable. Another alphabetical list is given of the key descriptive word in the title as compiled by a computer. (N.W.R.)

28302 GAMMASTRAHLUNG RADIOAKTIVER KÖRPER. MATHEMATISCH-NATURWISSENSCHAFTLICHE BIBLIOTHEK 26. (Gamma Irradiation from Radioactive Bodies. Mathematical-Natural Sciences Library No. 26). G. V. Gorshkov (G. W. Gorschkow). Leipzig, B. G. Teubner. Verlagsgesellschaft, 1960. 155p. (In German). (Originally issued in Russian in 1956).

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 3397.

28303 WAVE PROPAGATION IN A TURBULENT MEDIUM. V. I. Tatarskii. Translated from the Russian by R. A. Silverman. New York, McGraw-Hill Book Co., Inc., 1961. 295p.

The effects of atmospheric turbulence on the propagation of acoustic and electromagnetic waves in air are studied. Spectral representations are developed for propagation of the waves. Amplitude and phase fluctuations in short waves propagating in a turbulent atmosphere are calculated, considering both spherical and plane waves. Experimental results in the troposphere are reviewed. The twinkling and quivering observed in stellar images in telescopes are given detailed attention. (T.F.H.)

28304 PROGRESS IN CRYOGENICS. Volume 3. K. Mendelssohn, ed. New York, Academic Press Inc., 1961. 175p. $8.00.

Techniques are presented for the production, maintenance, application, and measurement of low-temperatures. Six articles are presented; separate abstracts are prepared for three. The three articles not abstracted are on low temperature heat exchangers, refrigeration cycles and devices, and cryogenic rocket propellants. (N.W.R.)

28305 HELIUM LIQUEFIERS. A. J. Croft (Oxford, Univ.). Progr. in Cryogenics, 3: 2-21(1961).

The principles, history, design, and performance of helium liquefiers are presented. All types of liquefiers are discussed including three proprietary liquefiers, and small and large laboratory-made liquefiers. The auxiliary equipment used with these units is also described. A brief discussion is presented on the storage and transfer of liquid helium, and the recovery of helium gas from the process. (N.W.R.)

28306 PARAMAGNETIC SUBSTANCES FOR NUCLEAR ORIENTATION. R. P. Hudson (National Bureau of Standards, Washington, D. C.). Progr. in Cryogenics, 3: 98-127 (1961).

The theory and experimental results of nuclear magnetic resonance are presented for paramagnetic salts. These salts are Tutton salts, double nitrates, ethyl sulfates, fluosilicates, and rubidium actinyl nitrates. Given in this cryogenics process are the general requirements, nuclear orientation process, energy levels, orientation parameter calculations, and the effect of interactions on the degree of orientation. (N.W.R.)

28307 DYNAMIC NUCLEAR ORIENTATION. C. D. Jeffries (Univ. of California, Berkeley). Progr. in Cryogenics, 3: 130-73(1961).

The solid state aspects of dynamic nuclear orientation are considered and some attention is given to the experimental techniques and results obtained. The discussion is limited primarily to solids at low temperatures. Descriptions and characteristics are given of the equipment used in dynamic orientation processes. Methods discussed for dynamic nuclear orientation include transient methods, paramagnetic resonance saturation, ferromagnetic and antiferromagnetic resonance saturation, orientation by hot conduction electrons, and acoustic excitation. Experiments reviewed and discussed are for the low temperature dynamic nuclear orientation of radioisotopes, dipolar coupling orientation, nuclear cooling, and Overhauser effect in metals, semiconductors, and free radicals. (N.W.R.)

28308 THEORY OF MARKOV PROCESSES. E. B. Dynkin. Translated from the Russian by D. E. Brown. Englewood Cliffs, N. J.. Prentice-Hall, Inc., 1961 and Oxford, London, Paris, Pergamon Press. 217p.

The logical foundations of the theory of Markov random processes are investigated. The Markov process may be described as follows: a particle is in motion in a space E during the interval of time (0, x). If the position of the particle is known at the instant t, supplementary information regarding the phenomena observed up till the instant t has no effect on prognosis of the motion after the instant t. The instant x at which the motion is cut off may be random. A general theory is built up which also covers non-stationary processes. Stationary processes are regarded as an important special case. (N.W.R.)

28309 IMPROVEMENTS IN OR RELATING TO LIGHT SOURCES. John Duncan Horsefall Hughes (to United Kingdom Atomic Energy Authority). British Patent 876,311. Aug. 30, 1961.

A light source consisting of a beta-emitting gas and a layer of phosphorescent material is designed with an apparent brightness greater than the intrinsic brightness of the surface of the phosphorescent material. The source is formed with a major portion of its internal surface area coated with a phosphorescent material and is of such a geometry that the light is collimated through the remaining area which is transparent. (D.L.C.)

Astrophysics and Cosmology

28310 (AFCRL-403) AN ANALYSIS OF THE ELECTRON DENSITIES IN REGION F OF THE IONOSPHERE. Scientific Report No. 147. E. R. Schmerling and D. Grant (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Apr. 1961. Contract AF 19(604)-4563. 34p. (AD-254858)

The electron-density height profiles for the mean quiet ionosphere, corrected for quasi-equilibrium conditions in the absence of movements, are examined to determine the parameters which enter into the electron-production and loss functions for region F. The shapes of the profiles are compared with theoretical curves observed from a model for electron loss with no seasonal change. While the orders of magnitude of the parameters are reasonable, the model requires a scale height for Washington D. C., which is greater in winter than in summer. The mechanism for electron loss is examined. While the change-transfer model is successful in accounting for some of the more striking features observed in region F, marked departures are observed. It is felt that these are linked to the seasonal anomaly, but no clear-cut seasonal effect could be extracted. A hypothesis of Ratcliffe is examined, for which both the production and loss functions can vary seasonally. By measuring the slopes of N-h profiles, the hypothesis is tested. While the scatter in the measured quantities is so large that no definitive conclusion can be stated, no contradictions are found to arise and the agreement between measurement and theory is as good as can be expected. (auth)

28311 (AFCRL-420) GEOMAGNETIC FIELD PERTURBATIONS DUE TO TRAPPED PARTICLES. John A. Apel (Maryland. Univ., College Park). Apr. 1961. Contract AF19(604)-3861. 82p. (AD-254337)

Particles trapped in a magnetic dipole field cause two distinct magnetic effects: (i) the gyration about the lines of force gives rise to a magnetization current which produces a positive perturbation interior and exterior to the trapped particle region; and (ii) the particles drift in azimuth and the resultant ring current decreases the driving field interior to the trapping region and increases it to the exterior. At the dipole center this effect is opposite to and three times as large as the diamagnetic effect (i). Explicit expressions are derived for the current and the perturbed field which would be observed as one progressed radially outward in the equatorial plane through the outer radiation belt. A maximum current density of about 10^{-8} amp/m^2 flows in the vicinity of 30,000 km geocentric distance. The total current is of the order of 5×10^6 amp. At the point of greatest particle concentration, taken as 5×10^6 electrons per cubic meter at 25,000 km, the magnetic field anomaly is of the order of −100 to −250 gamma, depending on how sharply defined is the inner edge of the radiation belt. With the help of these results, the "magnetic signature" of any reasonable trapped particle distribution can be synthesized provided the gradient of the total field thus obtained is nowhere positive. The calculations appear capable of explaining the Explorer VI results in terms of a radiation belt of limited radial extent, in the vicinity of 40,000 km. It appears difficult to explain the "fine structure" at 21,000 km in the Lunik I results, but the gross behavior of the magnetic field is fairly well reproduced. The magnitudes of the perturbations differ by a factor of 8, however. (auth)

28312 (AFSWC-TR-61-38) ARTIFICIAL INJECTION OF ELECTRONS INTO THE GEOMAGNETIC FIELD. David D. Elliott (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). May 1961. Contract AF29 (601)-2453. 126p.

A study was carried out on the feasibility of injecting 1-Mev electrons into the geomagnetic field from a satellite-borne electron accelerator, the types of geomagnetic experiments which can be performed with the injected electron beam, and the import of the experiments. The results of this study are presented. A satellite will require a payload capability of about 1,000 pounds in order to carry an electron accelerator with the desired characteristics. Two different types of accelerators are required, each for specific experiments. There are commercial accelerators which would be suitable for the injection experiments. One is a 1-Mev pulsed accelerator, 100 amps for 4×10^{-6} sec with a repetition rate of about one per second. The other is a 1-Mev d-c accelerator with an output current of 10^{-3} amps. The electron injection and trapping will not be seriously affected by either satellite charging or the diamagnetic field of the injected electrons. At altitudes greater than about four earth radii, magnetic shells can be filled with trapped electrons, and their trapping lifetime can be subsequently measured. The bounce time of trapped electrons can be measured to an accuracy of better than 1%. The geographic position of magnetic conjugate points can be measured, but the accuracy of the measurements is dependent on the type of radar system employed in the experiment. With either aircraft-borne radar or a complex ground radar system, it should be possible to measure the position to conjugate point to within 10 km. (auth)

28313 (GCA-TR-61-2-A) REACTION RATES. P. J. Nawrocki (Geophysics Corp. of America, Bedford, Mass.). Jan. 1961. Contract AF 19(604)-7405. 100p. (AFCRL-105; AD-252534)

Discussions are presented of dissipation processes for electrons in the ambient atmosphere, which include: photodetachment; attachment; electron-ion recombination; charge transfer and charged rearrangement; two-body and three-body ion-ion recombination; and associative and collisional detachment. Tabulated reaction rates are given for conceivable reactions among the atmospheric constituents. Discussions are also included of the quantum theory of reaction rates, and an estimation of the unknown reaction rates from quantum mechanics. (B.O.G.)

28314 (INSJ-40) A NOTE ON THE ROLE OF COLLIDING GALAXIES AS A SOURCE OF COSMIC RADIATION. Minoru Oda (Tokyo Univ. Inst. for Nuclear Study). July 1, 1961. 10p.

As an energetic phenomenon outside this galaxy, the collision of galaxies was considered as a source of cosmic radiation of energies from 10^{15} to 10^{19} ev. The discussion centers on whether or not colliding galaxies present sufficiently turbulent atmospheres in which charged particles are accelerated up to 10^{19} ev by Fermi's mechanism and if the observed flux of cosmic rays can be explained by this hypothesis. Studies indicated that this source alone would not produce nearly as much cosmic radiation in this energy range as is observed. The detection of cosmic gamma rays is discussed. (auth)

28315 (JINR-E-727) NEUTRINO AND THE MATTER DENSITY IN THE UNIVERSE. B. Pontekorvo (Pontecorvo) and Ya. Smorodinskii (J. Smorodinsky) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 8p.

The possibility is considered that the energy density of neutrinos and antineutrinos in the universe is comparable with the energy density associated with the mass of hydrogen. The assumption about a large energy density of neutrinos and antineutrinos does not contradict the available experimental data. Methods are discussed which might test such an assumption, which came about in considering the pc-asymmetry of the world together with the hypothesis of the existence of antiworlds. The great role of the Fermi $(e\nu)(e\nu)$ interaction in providing the transfer of the energy to the $\nu\bar{\nu}$ component is pointed out. It is shown that the small value of the density of visible kinetic energy, much smaller than the energy density connected with the rest mass of nucleons, does not contradict the fluctuation hypothesis, i.e., the statement that the matter and antimatter were separated as a result of fluctuations in a charge symmetrical universe. The fluctuation hypothesis requires only that sometimes in the past there was an energy density of neutrino and antineutrino by many orders larger than the nucleon energy density. (auth)

28316 (NP-tr-716) THE DRIFT OF IONIZED GAS IN THE UPPER ATMOSPHERE. V. P. Dokuchaev (Dokuchayev). Translated from Izvest. Vysshykh Ucheb. Zavedenii, Radiofiz., 4: No. 1, 5-39(1961). 67p.

A survey is presented of the theory of drifts and mechanisms of the formation of ionospheric irregularities in the upper atmosphere. A discussion is given of possible mechanisms to clarify the basic difficulties arising when attempting to give a theoretical interpretation of the phenomena of the formation of small-scale irregularities in the F-region. The questions considered may be called the electrodynamic meteorology of the upper atmosphere, since the electrodynamic forces exert an essential influence on the nature of the gas drift. (B.O.G.)

28317 RADIATION MEASUREMENTS DURING THE FLIGHT OF THE SECOND COSMIC ROCKET. S. N.

Vernov, A. E. Chudakov, P. V. Vakulov, Yu. I. Logachev, and A. G. Nikolaev. Translated from Iskusst. Sputniki Zemli, No. 5, 24-9(1960). ARS (Am. Rocket Soc.) J., 31: 967-70(July 1961).

The radiation fields existing between the earth and the moon were measured by a Soviet cosmic rocket launched on Sept. 12, 1959. The spectra at altitudes from $8 \cdot 10^3$ to $120 \cdot 10^3$ km above the center of the earth, in the vicinity of the outer Van Allen belt, were measured. The data from 0 to $40 \cdot 10^3$ km above the surface of the moon indicated that no increased radiation belt existed in this area. Measurements were made with scintillation and gas discharge counters, some of which were located outside the vehicle. (T.F.H.)

28318 THE STABILITY OF THE STATIONARY MAGNETOHYDRODYNAMIC MOTIONS. PART I. Cataldo Agostinelli. Atti accad. nazl. Lincei. Rend., Classe sci. fis., mat. e nat., 477-84(Dec. 1960). (In Italian)

The Rayleigh energy principal has been applied to the study of the static stability of a highly conducting completely ionized plasma. However, the application of this principal to the stability of an indefinite stationary magnetohydrodynamic motion is very complex and difficult. This question is studied by considering a barotropic fluid of high electrical conductivity which is moving in a field confined by a rigid perfectly conducting wall. On the hypothesis of a permanent motion of the fluid satisfying all proper surface conditions, a perturbing motion is considered, assuming as unknown the displacement of a fluid particle with respect to the simultaneous position which the perturbation occupies. The motion is then considered from a lagrangian point of view, and the density and the pressure are determined as a function of analogous qualities in the perturbation and of the displacement. A differential equation is established for the magnetic field analogous to the Helmholtz equation for the vortex. The integral of this equation provides the intensity of the magnetic field as a function of the initial data and as a function of the corresponding magnetic field of the perturbation and of the displacement. (J.S.R.)

28319 NEUTRAL AND IONIZED INTERPLANETARY HYDROGEN. J. W. Chamberlain and J. C. Brandt (Yerkes Observatory, Williams Bay, Wis.). Mem. soc. roy. sci. Liège (5), 4: 448-55(1961). (AFOSR-TN-60-623). (In English)

Approaches to the problem of interplanetary densities and temperatures are compared. Hydrodynamic problems are considered, and the case against a solar wind arising from coronal expansion is given. The ionization ratio in solar space is discussed and conclusions are given. (L.N.N.)

28320 COSMOLOGICAL IMPLICATION OF PHYSICAL CONSTANTS. Satio Hayakawa (Nagoya Univ., Japan) and Hajime Tanaka. Progr. Theoret. Phys. (Kyoto), 25: 858-60(May 1961). (In English)

Numerical values of the gravitation constant and Planck's constant are derived through a cosmological approach. The gravitation constant is computed though the mass-energy relation in which loss of mass in a region is compensated by a gravitational potential energy change. Similarly, through steady state cosmology, Planck's constant is determined. A possible application to other physical constants is implied. (L.N.N.)

28321 EVOLUTION OF A STAR WITH INTERMEDIATE MASS AFTER HYDROGEN BURNING. Chushiro Hayashi, Minoru Nishida, and Daiichiro Sugimoto (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 1053-6(June 1961). (In English)

Evolution of a star of $4M\odot$ after formation of a dehydrogenized core and a hydrogen burning shell, is calculated to the stage when helium has almost burned out in its central region. The mass $4M\odot$ is used to obtain a full interpretation of the H-R diagram together with results for stars of $15.6M\odot$ and 1.2M. (L.N.N.)

28322 GENERAL SURVEY ON SOLAR PHENOMENA. M. Minnaert (Sterrewacht Sonnenborgh, Utrecht). Rend. Scuola intern. fis. "Enrico Fermi," Corso XII (1959), 1-38 (1960). (In English)

The properties and compositions of various solar regions, including the core, the outer convective shell, and the atmosphere, are studied under quiescent conditions. The characteristics of local solar disturbances, such as sunspots, faculae, prominences, filaments, and flares, are also examined. (T.F.H.)

Cosmic Radiation

28323 (NP-10581) STUDIES OF NATURAL AND INDUCED RADIOACTIVITIES. Final Report. (California. Univ., La Jolla). June 15, 1961. Contract DA-04-495-ORD-1275. 103p. (AROD-2224:1)

Three papers are presented on the topic of cosmic ray-produced radioactivities in meteorites. Separate abstracts were prepared for each paper. (D.L.C.)

28324 (NP-10581(p.5-46)) RADIOACTIVE SPECIES PRODUCED BY COSMIC RAYS IN IRON METEORITES. M. Honda, J. P. Shedlovsky, and J. R. Arnold (California. Univ., La Jolla). (AROD-2224:2)

The radioisotopes Be^{10}, Al^{26}, Cl^{36}, K^{40}, and Mn^{53} were measured in four iron meteorites: Grant, Williamstown, Odessa, and Canyon Diablo. Each sample was recycled to constant activity, using a different chemistry for each recycle wherever possible. The samples were counted with a low-level β-counter, except for Mn^{53} whose x-rays were measured. The isotope ratios were approximately constant for each meteorite, except for Mn^{53} where a depth effect is visible. The cosmic-ray ages of Williamstown and Grant are about the same. (auth)

28325 (NP-10581(p.47-74)) RADIOACTIVE SPECIES PRODUCED BY COSMIC RAYS IN THE AROOS IRON METEORITE. M. Honda and J. R. Arnold (California. Univ., La Jolla). (AROD-2224:3)

The iron meteorite Aroos fell on November 24, 1959. The contents of eighteen radioactive nuclides were measured in this meteorite by wet chemical methods. A low-level x-ray proportional counter was used for a group of electron-capture species; β and γ counting were used for the others. The activities of the long-lived species Be^{10}, Al^{26}, and Mn^{53} were close to those found previously in the meteorites Williamstown and Grant. The value for Cl^{36} was also consistent with earlier work. Much less K^{40} was found, indicating a shorter bombardment age for Aroos. Comparison of the activities of the groups $Mn^{53}-Mn^{54}$, $Ti^{44}-Sc^{46}-Ca^{45}$, $Na^{22}-Al^{26}$, and $Cl^{36}-Ar^{37}-Ar^{39}$ (data of Fireman and de Felice (1960)) indicates constancy of the cosmic ray flux over millions of years within a factor of two or three. Comparison of the groups $Mn^{54}-V^{49}-Na^{22}$ and $Ti^{44}-Si^{32}$, among others, shows the great importance of low-energy particles in synthesizing products close to the target mass. (auth)

28326 (NP-10581(p.75-115)) THE RECORD OF COSMIC RAY INTENSITY IN THE METEORITES. J. R. Arnold and M. Honda (California. Univ., La Jolla) and D. Lal Tata (Inst. of Fundamental Research, Bombay). (AROD-2224:4)

Extensive data now exist on the abundance of radioactive and stable nuclides produced by cosmic rays in iron me-

teorites. Half lives of radioactive species range from 16 days to 1.2×10^9 years. These data are compared with calculated production rates based on derived energy spectra of nuclear-active particles in meteorites and experimental excitation functions. Both relative and absolute amounts of the various species are in approximate agreement if the flux of cosmic rays is assumed not to have varied. The variation, averaged over the half life of each species, does not appear to exceed a factor of two in any case, except possibly K^{40}, where the data are still insufficient. It is concluded that the cosmic ray intensity has been constant, in this sense, at least over millions of years. (auth)

28327 EFFECT OF WORLD-WIDE CHANGES OF ISOTROPIC COSMIC RAY INTENSITY ON THE DAILY VARIATION OF COSMIC RAYS. R. P. Kane (Physical Research Lab., Ahmedabad. India). Indian J. Phys., 35: 213-35(May 1961).

Various methods of evaluating the 12 bi-hourly values required for a study of the daily variation of cosmic ray intensity are discussed. Estimates are obtained of the distortions produced in the genuine daily variation due to slope, curvature and short-term effects of the world-wide fluctuations in isotropic cosmic ray intensity. A method for correcting for such effects is suggested and examined critically. (auth)

28328 CHARACTERISTICS OF HIGH-ENERGY NUCLEAR INTERACTIONS AT AND ABOVE 10^{14} eV. A. Ueda and C. B. A. McCusker (Univ. of Sydney). Nuclear Phys., 26: 35-51(1961). (In English)

An attempt was made to explain the changes in slope of the γ ray energy spectrum around γ energies of 1000 Bev at 220 g/cm^2 and 740 g/cm^2 from the top of the atmosphere, the change in slope of the extensive air shower density spectrum at sea level at densities of about 1000 particles/m^2, the double change in slope of the energy spectrum of γ rays from local nuclear interactions at 220 g/cm^2, the absence of such a change at sea level, and the μ-meson spectrum at sea level. The cascade theory developed by Fukuda, Ogita, and Ueda was used together with the following basic hypotheses: in a nucleon-nucleon collision the maximum pion energy in the CMS is about 25 Bev, the fractional energy going into the pion component decreases with increasing primary energy (from 30% at 500 Bev to 5% at 5×10^7 Bev), and at very high energies a large fraction of the energy goes into a few heavier particles and thence some of this, via the Σ^0, into the electromagnetic cascade. Good agreement between theoretical predictions and experimental results was obtained. (auth)

28329 SECONDARY COSMIC-RAY PHOTONS BELOW CASCADE ENERGY. Kinsey A. Anderson (Univ. of California, Berkeley). Phys. Rev., 123: 1435-9(Aug. 15, 1961).

Investigations with small unshielded scintillation crystals carried through the atmosphere by balloons show large fluxes of photons in the energy region 30 to 300 kev in equilibrium with the primary cosmic ray beam. At 90 g cm^{-2} depth the flux is about 22 photons cm^{-2} sec^{-1} compared with a charged particle flux determined from a Geiger tube of 1.9 cm^{-2} sec^{-1} at this same depth. The photon flux at zero depth, taken to be the albedo of this secondary cosmic-ray component, has been estimated by extrapolation to be 8 photons cm^{-2} sec^{-1} greater than 30 kev. (auth)

28330 THE DIFFERENTIAL ELECTRON DENSITY SPECTRUM OF AIR SHOWERS AT HIGH DENSITIES. R. J. Reid (University Coll. of the West Indies, Jamaica), K. Gopaulsingh, D. E. Page, M. Idnurm, C. B. A. McCusker, J. Malos, D. D. Millar, and G. Winterton. Proc. Phys. Soc. (London), 78: 103-12(July 1, 1961).

The density spectrum of cosmic-ray air showers has been measured using Wilson cloud chambers in two different density regions. From 50 to 500 particles per square meter the differential spectrum can be approximated by a power law of exponent -2.5, in good agreement with many previous results. Above 1100 particles per square meter the measured exponent is -3.9 ± 0.5. The result is compared with recent experiments using emulsion chambers and an explanation in terms of the characteristics of high energy nuclear interactions is outlined. (auth)

28331 COLLOQUIUM ON THE EFFECTS OF THE SOLAR ACTIVITY ON THE COSMIC RAY INTENSITY AT THE EARTH. F. Bachelet (Università, Rome and Commissione Italiana per l'Anno Geofisico Internazionale, Rome). Rend. Scoula intern. fis. "Enrico Fermi," Corso XII (1959), 365-70(1960). (In English)

The effects of solar activity on cosmic radiation are classified as: sudden increases associated with solar flares; Forbush decreases; 27-day recurrences associated with the solar synodic period; and 11-year variations associated with the sunspot cycle. The relation between the solar activity and the Van Allen radiation belts is examined. (T.F.H.)

28332 COSMIC RADIATION TRANSITION EFFECTS IN COMBINED ABSORBERS. E. Fridlender (Inst. of Nuclear Physics, Rumania). Rev. phys., Acad. rep. populaire Roumaine, 5: 343-53(1960). (In Russian)

Anomalies observed in cosmic radiation transition curves measured in lead and aluminum absorbers are analyzed in order to obtain new data for developing an improved meson shower detector. (R.V.J.)

28333 NUCLEAR-ACTIVE PARTICLES IN ATMOSPHERIC SHOWERS. Ya. S. Babetski, Z. A. Buya, N. L. Grigorov, E. S. Loskevich, E. I. Massalski, A. A. Oles, V. Ya. Shestoperov, and S. Fisher (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 13-21(July 1961). (In Russian)

Broad and "young" atmospheric showers were studied at sea level with an arrangement of 128 ionization chambers covering an area of 10 m^2. Near the axes of extensive showers the energy of nuclear-active particles was found to be less than 50% of the energy of the electron-photon component. The mean inelasticity coefficient of nuclear-active particles of extensive showers exceeds 0.6 – 0.75. The nuclear-active component is practically absent in a large fraction of "young" atmospheric showers. (auth)

28334 AN ANALYSIS OF COSMIC RAY SHOWERS PRODUCED BY HIGH ENERGY PRIMARY PARTICLES BASED ON THE EXCITED NUCLEON MODEL. L. A. Sanko, Zh. S. Takibaev, P. A. Usik (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 139-45(July 1961). (In Russian)

High energy ($E > 10^{11}$ev) interactions of cosmic ray nucleons in photographic emulsions are analyzed on the basis of the excited nucleon model. The angular distribution of excited nucleons in the cms is presented. Anisotropy of the angular distribution of the shower particles and the multiplicity of the shower particles are examined in relation to the velocity and emission angle of the excited nucleon. The experimental results are compared with the predictions of the single-meson pole approximation. (auth)

Criticality Studies

28335 (ANL-6357) CRITICAL EXPERIMENTS FOR THE PRELIMINARY DESIGN OF THE ARGONNE HIGH FLUX REACTOR. J. W. L. de Villiers, ed. (Argonne Na-

tional Lab., Ill.). June 1961. Contract W-31-109-eng-38. 79p.

Critical experiments were performed with two assemblies simulating a cold clean, and an end-of-cycle, Argonne High Flux Reactor, core. Data were obtained for flux distributions; cadmium ratios; temperature and void coefficients; and control rod, beam hole, and reflector worths. The data obtained furnished confirmation of theoretical predictions. The peak 2200-m/sec flux per unit power was measured as 3×10^7 n/(cm^2)(sec)(watt) for both cores. The two cores had internal H_2O thermal columns, 12.7 cm × 12.7 cm × 50.8 cm. These were enclosed by 100-liter fuel zones. The radial reflector was 90% beryllium containing 10% H_2O plus Plexiglas by volume. The top and bottom reflectors were H_2O. The critical mass was 3.58 kg U^{235} with a 1.16 metal-to-water ratio in the fuel zone. The critical mass with a 1.60 metal-to-water ratio, taking into account 34.3 kg Type 304 stainless steel, was 7.15 kg U^{235}. (auth)

28336 (CRRP-894) SOME CLOSE-PACKED LATTICES IN LIGHT WATER AND HEAVY WATER. PART I. BUCKLING MEASUREMENTS. R. G. Jarvis, G. J. Phillips, and W. H. Walker (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Apr. 1961. 40p. (AECL-1254)

Measurements of buckling were made in an exponential system for a set of twelve lattices. The fuel was in rods 1.28 in. in diameter, in aluminum cans, and was arranged in square lattices at spacings of 1.60, 2.11, and 3.20 in. At each spacing the buckling was measured for natural and depleted uranium in light water and in heavy water. The depleted uranium contained 0.26% of U-235. (auth)

28337 (HW-68405) A SEMI-EMPIRICAL METHOD OF ESTIMATING MATERIAL BUCKLINGS FOR SLIGHTLY ENRICHED URANIUM–WATER LATTICES. C. L. Brown (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1961. Contract AT(45-1)-1350. 39p.

The calculated bucklings are compared with experimental bucklings measured on uranium rods in water at enrichments of 1, 2, and 3 per cent U^{235}, for rod diameters up to three inches. Twenty two such measurements are included. Bucklings are calculated using the one-group criticality equation. Lattice parameters are calculated. The maximum material bucklings obtained are biased high (conservative from the standpoint of nuclear safety). The bias, however, is not unreasonably large: for 1.0-inch diameter rods at 1.0 per cent U^{235}, the bias is 130 ± 320 microbucks; for 0.5-inch diameter rods at 3.0 per cent U^{235}, the bias is 190 ± 330 microbucks; and for 0.3-inch diameter rods at 5.0 per cent U^{235}, the bias is 320 ± 420 microbucks. Maximum bucklings and minimum critical masses are presented for water-reflected lattices of 1.03, 2.0, 3.063, and 5.0 per cent U^{235} enriched uranium rods in light water. Extrapolation lengths are estimated from experimental measurements. (auth)

28338 NUCLEAR SAFETY OF UO_2–ThO_2–H_2O SYSTEMS. D. B. Wehmeyer and K. E. Roach (Babcock and Wilcox Co., Lynchburg, Va.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 14: 189-99(July 1961).

A large number of clean critical assemblies with H_2O moderator and reflector have been correlated with a modified two-group theoretical model. Agreement of theory and experiment is good over a wide range of moderation, geometry, and material composition. Within the range of correlation, the model can be used to determine mass and geometry limits for processing fissionable material. This method is used to determine minimum critical conditions of UO_2–ThO_2–H_2O systems. Appropriate safety factors are derived and safe processing limits are determined. (auth)

Elementary Particles and Radiations

28339 (AFOSR-1075) CROSS SECTIONS AT HIGH ENERGIES. Steven Weinberg (California. Univ., Berkeley). [1960]. Contracts AF 49(638)-327 and ONR r-222 (60) (NRO 41-221). 9p.

It is proved that the total cross sections $\sigma_\pm$ (E) for a particle (+) and its antiparticle (−) approach each other as the energy $E \to \infty$. It is assumed that the difference σ_+ (E) − σ_- (E) does not change sign an infinite number of times, and that the odd part of the forward scattering amplitude remains bounded, as $E \to \infty$. This second assumption may be slightly relaxed. (T.F.H.)

28340 (CTSL-29) PION PRODUCTION IN 300 GEV NUCLEON-NUCLEON COLLISIONS. Keith R. Watson and Denis Hankins (California Inst. of Tech., Pasadena. Synchrotron Lab.). June 5, 1961. Contract AT(11-1)-68. 14p.

Recent theoretical investigations of high energy nucleon-nucleon collisions supported the two-center model of multiple meson production. To facilitate a prediction of the most probably distribution of shower particles as a function of laboratory energy, Farley's kinematical treatment of the "two-fireball" model was employed. A statistical determination of the multiplicity of pion (including neutrals) production per collision was assumed to be valid with possible corrections suggested through restrictions imposed by experimental values of the inelasticity, K_π. (auth)

28341 (GCA-TR-61-12-A) ENERGY LOSS PROCESSES OF SOLAR CORPUSCLES IN AIR. Scientific Report No. 4. P. J. Nawrocki and R. Papa (Geophysics Corp. of America, Bedford, Mass.). Feb. 1961. Contract AF 19(604)-7405. 109p. (AFCRL-26; AD-252533)

Energy loss processes are discussed for interactions of electrons, photons, and protons in the air, and atmospheric radiative phenomena caused by perturbations of energetic photons and particles. Discussions are included of: the main characteristics of diatomic molecules; the Morse function for the diatomic molecule; Morse diagrams of O_2, N_2, and NO; lifetimes of metastable states of molecular species of oxygen, nitrogen, and nitric oxide; selection rules for radiative transistions of atomic electronic states; the Franck-Condon Principle; and the non-crossing rule. (B.O.G.)

28342 (NP-10305) CONTRIBUTION A L'ÉTUDE DE LA DIFFUSION (π^+p) A 120 MeV, PAR L'EXPLOITATION DES CLICHES DE CHAMBRE A BULLES (THESE). (Contribution to the Study of (π^+p) Scattering at 120 Mev by Utilization of Photographic Plates in Bubble Chambers (thesis)). B. Aubert (Grenoble, France. Universite). June 18, 1960. 86p.

The results of an investigation of (π^+,p) scattering made on 20000 photographs of a propane bubble chamber are reported. Before giving a report of the experimental results, the theoretical bases are reviewed, and the apparatus used is described. Results obtained previously relative to the α_3 phase are not in agreement with theoretical predictions. The aim of the present investigation was to study the scattering with good precision. The bubble chamber permitted the materialization of (π^+,p) collisions by visible tracks forming a star with three branches. After the determination of the proton branch, the angular distribution in the

center-of-mass system was studied, and the dephasing was deduced. (J.S.R.)

28343 (NP-10504) THE GYROMAGNETIC RATIO OF THE ELECTRON IN CLASSICAL MECHANICS. H. C. Corben (Space Technology Labs., Inc., Los Angeles). Feb. 27, 1961. 12p. (9844-0004-RU-000)

It is shown that according to classical relativistic point-particle mechanics a charged particle with spin acquires a magnetic moment because it may move in a circle or a helix even if no forces are acting on it. The equations of motion lead to the observed gyromagnetic ratio of the electron, apart from radiative corrections. (auth)

28344 (PAN-247/IX) THE MOTION OF A CHARGED PARTICLE IN THE CIRCULARLY POLARIZED ELECTROMAGNETIC WAVE. A. Legatowicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 6p.

The motion of a charged particle in a circularly polarized electromagnetic wave and a homogeneous constant magnetic field was investigated. The exact solution of the non-relativistic equation of motion in the form of an integral is given. The solution of an approximate equation neglecting the terms of the order of v/c is discussed. In the case of cyclotron resonance the considered field was very effective from the point of view of the acceleration of plasma particles. (auth)

28345 (UCRL-9614) GENERATION OF THREE-BODY PRODUCTION AND DECAY PROCESSES FOLLOWING PHASE-SPACE DISTRIBUTION BY MONTE CARLO METHOD. John A. Kadyk (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 10, 1961. Contract W-7405-eng-48. 66p.

A program is given, using FORTRAN subroutines, for finding laboratory and c. m. angular and momentum distributions from three-body decay and production processes. The uses of the program are given as examples for $\pi^0 \rightarrow \gamma_1 + \gamma_2$, and for internal conversion of γ radiation. (T.F.H.)

28346 (AEC-tr-4773) INTERFERENCE RADIATION OF VERY FAST ELECTRONS. M. L. Ter-Mikaelian. Translated from Zhur. Eksptl'. i Teoret. Fiz., 25: 296-306 (1953). 12p.

The radiation of very fast electrons in a crystal was considered. It is shown that interference effects must be taken into account when the momentum transferred to the system in the direction of the electron beam equals the momentum corresponding to the dimensions of the elementary cell. This occurred for energies $E_0 > mc^2(a/4\pi\lambda)\epsilon/(1-\epsilon)$, where a is the lattice constant, λ is the Compton wavelength, and ϵ is the energy of the emitted quantum with the initial energy taken as unity. For such sizeable energies the radiation in a single crystal was very strong at certain angles of inclination, and at others 5 to 25% less than in an amorphous substance with the same number of particles. Energy losses after averaging over all angles of inclination were the same as for an amorphous substance. A formula was derived for the bremsstrahlung of a narrow electron beam along a main axis of a cubic crystal. It differed sharply from the usual formula for the bremsstrahlung in an amorphous substance. (auth)

28347 (JPRS-7816(p.30-51)) THE PROPERTIES, PRODUCTION AND DECAY OF STRANGE PARTICLES. An-shing Ho. Translated from Wu Li Hsueh Pao, 15: 219-29(May 1959).

A cloud chamber with a volume of $30 \times 30 \times 10$ cm^3 in a magnetic field of 6200 gauss was operated in the laboratory on a snow capped mountain in Yunnan Province at an altitude of 3185 m above sea level. From 30,000 pairs of photographs taken within this chamber, 105 V^0 were obtained, and 43 out of these 105 V^0 obtained may be classified as 26 θ_1^0, 16 Λ^0 and 1 θ_2^0. Based upon the research work done on these particles, the following results were obtained: Q value: $Q_{\Lambda^0} = (36.2 \pm 2.5)$ Mev; $Q_{\theta_1^0} = (233 \pm 11)$ Mev; mean lifetime: $\tau_{\Lambda^0} = (3.19^{+2.42}_{-0.92}) \times 10^{-10}$ sec., $\tau_{\theta_1^0} = (1.14^{+0.49}_{-0.27}) \times 10^{-10}$ sec. The momentum distribution found for Λ^0 and θ_1^0 particles had no appreciable difference from earlier results. $N(\Lambda^0)/(N\theta_1^0)$ was found to equal 0.51 ± 0.22 (corrected number in lead). The angular distribution of the decay products of the Λ^0 and θ^0 particles in the rest system had no marked asymmetry. The lifetime of one θ_2^0 particle was estimated to be 10^{-9}sec in the rest svstem. The decay mode of this θ_1^0 particle is probably $\theta_2^0 \rightarrow \pi^- + \pi^+ + \pi^0$ or $\theta_2^0 \rightarrow \pi^\pm + \mu^\pm + \nu$. (auth)

28348 (JPRS-7816(p.52-62)) ON THE ANGULAR DISTRIBUTION OF THE DECAY PRODUCTS OF PARTICLES OF ARBITRARY SPIN. Chung-mo Ch'en, Tsa-hsiu Ho, Ting-chang Hsi, and Hung-yuan Chu. Translated from Wu Li Hsueh Pao, 15: No. 5, 254-61(May 1959).

The angular distribution of the decay products of a particle of arbitrary spin decaying into a particle of spin zero and a particle of spin ½ was investigated. The expressions for the expansion coefficients are derived. It was found that coefficients of terms of even order spherical harmonics are independent of the detailed form of the interaction Hamiltonian inducing the decay process. But the expansion coefficients of terms of odd order spherical harmonics depend on a parameter α, which is a measure of the interference between the parity conserving and the parity nonconserving interaction. The maximum values which can be taken by the various coefficients are given. It was found that the maximum values of even coefficients increase with the value of the spin of the initial particle, while those of the odd coefficients decrease correspondingly. The expression for the density matrix of the initial particle as a function of these expansion coefficients is also given. It can be used to determine the state of polarization of the initial particle and the interference between the parity conserving and the parity nonconserving interactions, when the expansion coefficients are known. (auth)

28349 (JPRS-7816(p.63-76)) MASS DIFFERENCE BETWEEN NEUTRON AND PROTON. Kwang-chao Chou. Translated from Wu Li Hsueh Pao, 15: No. 5, 269-76(May 1959).

A study was undertaken to determine the mass difference between the neutron and proton. An attempt was therefore made to calculate theoretically the electromagnetic mass of the nucleus. The problem was approached with the recently developed dispersion relation theory. In principle, this theory includes all effects of strong actions and automatic renormalization to eliminate the difficulty of divergence. As to the electromagnetic action, the micro-stirring method was used where the neglected quantity is about $\alpha^3 = (1/137)^2$. The connection between mass notation and the Compton effect of the mesophoton is discussed. The theory of dispersion relation was used to handle the Compton effect of mesophoton. The calculation of single nucleus item in the dispersion relation is given. An estimate was also made of the contribution of other items. (auth)

28350 (JPRS-8182(p.24-8)) EFFECT OF THE STRUCTURE OF THE NUCLEON ON THE CAPTURE OF THE μ-MESON BY THE PROTON. H. Y. Tzu, T. H. Ho, and Y. B. Dai. Translated from Wu Li Hsüeh Pao, 15: 521-4 (Oct. 1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 8940.

28351 (UCRL-Trans-702) SEARCH FOR ANOMALIES IN THE ENERGY DEPENDENCE OF THE CROSS SECTION OF REACTION $p + p \rightarrow d + \pi^+$ IN THE THRESHOLD REGION OF PAIR FORMATION OF π-MESONS. Yu. (Iu.) K. Akimov, O. V. Savchenko, and L. M. Soroko (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). Translated by S. Shewchuck for Univ. of California from JINR-P-710. [1961]. 8p

The differential cross section (σ) for the reaction $p + p \rightarrow d + \pi^+$ is small and almost energy-independent in the energy range 574 to 648 Mev. A search is made for anomalies in σ in this range, near the thresholds of p-p interactions yielding $p + p + \pi^0 + \pi^0$, $d + \pi^0 + \pi^+$, $n + p + \pi^0 + \pi^+$, $p + p + \pi^+ + \pi^-$, $n + n + \pi^+ + \pi^+$, $d + \omega^+$, and $n + p + \omega^+$. It is concluded that if any anomalies exist, their magnitude is no greater than 2% of the average value of σ. (T.F.H.)

28352 INTRINSIC MAGNETIC MOMENT AS A NON-RELATIVISTIC PHENOMENON. A. Galindo and C. Sanchez Del Rio (Junta de Energia Nuclear, Madrid). Am. J. Phys., 29: 582-4(Sept. 1961).

It is shown that the Hilbert space of spin $\frac{1}{2}$ particles, elementary under the Galilei group, decomposes into two subspaces invariant under the "static" Galilei group. This implies a linearization of the Schrödinger equation and suggests a square-root procedure to introduce electromagnetic interactions leading to the correct expression for the intrinsic magnetic moment of the particle without using relativity. (auth)

28353 STUDY OF THE INTERACTIONS PRODUCED IN NUCLEAR EMULSIONS BY 300-MEV π^- MESONS. Brigitte Willot-Chemel. Ann. phys. (13), 6: 703-34(May-June 1961). (In French)

A stack of nuclear emulsions of the G5 type was exposed to a beam of 300-Mev π^- mesons. After defining the position of the plate at the moment of exposure, a study was made of the beam in its totality, the ionization of the trajectories of the particles composing it, the parasite contamination by electrons and other mesons, and the dispersion at beam entry and departure from the stack. Within the framework of the study of the beam dispersion, the theoretical value of the constant of multiple scattering K is verified. The interactions of the π^- mesons with the complex nuclei of the nuclear emulsion are then studied. The creation of a π^+ meson by a collision of a π^- meson with emulsion nuclei is investigated. (J.S.R.)

28354 PHOTON TRANSPORT THEORY. R. K. Osborn and E. H. Klevans (Univ. of Michigan, Ann Arbor). Ann. Phys. (N. Y.), 15: 105-40(Aug. 1961).

A first order, momentum-configuration space transport equation for photons is derived for low energy (nonrelativistic) systems. The derivation is first order in the sense that the transition probabilities characterizing photon scattering emission and absorption are computed only to the first nonvanishing order by conventional perturbation methods. The present approach provides an essentially axiom-deduction development of the theory of radiative transfer (albeit via several ill-evaluated approximations) within the context of which various processes and their interrelationships may be investigated. Most of these processes have hitherto been studied only phenomenologically and usually piecemeal. Specific application to photon scattering, cyclotron radiation, recombination radiation, de-excitation radiation, and bremsstrahlung is made. The derivation of an H-theorem for photon-particle systems is sketched; and contact is made with the usual statistical mechanical treatment of the equilibrium states of such systems. It is also shown that some aspects of collective particle behavior can be introduced quite naturally into the description of photon transport in the fully ionized plasma. (auth)

28355 FIVE YEARS OF WORK OF THE JOINT INSTITUTE OF NUCLEAR RESEARCH. D. I. Blochintsev. Atomnaya Energ., 10: 317-42(Apr. 1961). (In Russian)

A review is given of work at the Joint Inst. of Nuclear Research during 1956 to 1961. Data on isotropic invariance, meson and nucleon interactions, dispersion relations for meson scattering on nucleons, and other data on nucleon and meson interactions are included. Photographs are included of some of the major research tools. (R.V.J.)

28356 SPECTRUM OF SCATTERED GAMMA RAYS. V. S. Anastasevich. Atomnaya Energ., 10: 389-90 (Apr. 1961). (In Russian)

Gamma scattering was mathematically analyzed by the steady-state condition previously applied by S. Flugge (Phys. Zr. 11, 21/22, 445, 1943) in studies of delayed neutron spectra. (R.V.J.)

28357 MONTE CARLO CALCULATIONS OF THE TRANSMISSION OF GAMMA RAYS FROM A TWO-DIMENSIONAL Cs^{137} SOURCE THROUGH ALUMINIUM. A. F. Akkerman and D. K. Kaipov. Atomnaya Energ., 10: 391-2(Apr. 1961). (In Russian)

Polynomial expansion developed by L. Spence and U. Fano (J. Res. Nat. Bur. Standards, 46, 446, 1951) through accumulation factors (energy, doses, absorption, etc.) was successfully applied in an evaluation of multiple radiation scattering. The energy accumulation factor (Cs^{137} source) as a function of layer thickness, the energy factor of Co^{60} emission, and the dosage factors of Cs^{137} emission and reflection are plotted and analyzed. (R.V.J.)

28358 PROPAGATION IN AIR OF THE γ-RAY FROM A MOMENTARY POINT SOURCE. O. I. Leipunskii, A. S. Strelkov, A. S. Frolov, and N. N. Chentsov. Atomnaya Energ., 10: 493-500(May 1961). (In Russian)

The problem of propagation in an infinite air space of 1-Mev γ quanta from an isotopic point source was resolved by the Monte Carlo method. Relations were developed for emission intensities as functions of time for γ radiation emitted into the observation point from various solid angles and for time-dependent energy spectra of scattered γ rays at various distances from the source. Accumulation factors and differential energy spectra of γ-ray scattering for a continuous source, angular distribution of intensity, and angular energy spectra of scattered γ-ray intensities for three distances from the source were derived by integrating the transient time distribution. (tr-auth)

28359 THE EMISSION FROM A VOLUME SOURCE IN THE PRESENCE OF SURFACE ACTIVITY. E. E. Kovalev and D. P. Osanov. Atomnaya Energ., 10: 515-17(May 1961). (In Russian)

A concept of a dosage factor for surface activity S is introduced after determining its relation to the γ-radiation volume source dosage in the presence of surface activity and to the dosage under identical conditions but without surface activity. Further studies are made of a cylindrical solid, liquid, or gaseous source with a thin layer of radioactive substance evenly distributed on the side-wall surfaces. The magnitudes S at a distance of 150 cm from the cylinder axis are tabulated, and a nomogram determining the finite relation of the total surfaces and volume activities is plotted. (R.V.J.)

28360 ANGULAR DISTRIBUTION OF FAST PHOTONEUTRONS. R. G. Baker and K. G. McNeill (Ontario

Cancer Clinic, Toronto and Univ. of Toronto). Can. J. Phys., 39: 1158-71(Aug. 1961).

The angular distributions and the yields of the high-energy neutrons emitted in photodisintegration were studied by silicon detectors (25 elements) and aluminum detectors (6 elements). With the silicon detectors, systematic variations are apparent in the coefficient a_2 of $W(\theta) = a_0 (P_0 + a_2 P_2)$, and these variations are interpreted in terms of the Wilkinson shell model of photonuclear reactions. (auth)

28361 ON THE THEORY OF BREMSSTRAHLUNG EMISSION CONSIDERING MULTIPLE SCATTERING AND EVALUATION OF FOKKER-PLANCK METHOD. I. I. Gol'dman (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 13: No. 6, 55-61(1960). (In Russian)

Direct integral equations are developed without utilizing the Fokker-Planck approximation. By a series of conversions the problem is reduced to an ordinary second-order differential equation. The analysis confirms Migdal procedures, and it is shown that more accurate results can be achieved by simple integration. (R.V.J.)

28362 DECAY OF $K_{e\mu s}$ MESONS. S. A. Gadzhiev. Izvest. Akad. Nauk Azerbaidzhan. S.S.R., Ser. Fiz.-Mat. i Tekh. Nauk, No. 4, 73-8(1960). (In Russian)

Dirac particles with oriented spin are used in studies of various angular correlations, energy spectra, and longitudinal polarization in order to determine the character of weak electron interactions and the variation of decay interaction theory for K mesons. (R.V.J.)

28363 ON THE LONGITUDINAL POLARIZATION OF PARTICLES IN FOUR-FERMION WEAK INTERACTIONS. B. K. Kerimov (Moscow State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 157-62(Jan. 1961). (In Russian)

The angular distribution and longitudinal polarization of particles in polarized free-fermion in-flight decay into three fermions, $b \rightarrow a + c + d$, and respectively for $b + d \rightarrow a + c$, were calculated. (R.V.J.)

28364 ELECTRON–POSITRON CORRELATION IN PAIR FORMATION BY POLARIZED γ QUANTA. B. K. Kerimov and I. M. Nadzhafov (Moscow State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 163-5 (Jan. 1961). (In Russian)

Integral cross sections for electron–positron formation by photons and for delayed electron emission in a nuclear field are found. (R.V.J.)

28365 BACK SCATTERING OF ELECTRONS. G. D. Archard (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). J. Appl. Phys., 32: 1505-9(Aug. 1961).

The behavior of a stream of electrons penetrating a solid target is studied with a view to determining the proportion which return to the surface and pass back into space. Two existing theories (diffusion and large-angle single elastic scattering) are adapted to this end. These theories predominate for high and low atomic numbers, respectively. A combination of the two theories agrees well with experiment. (auth)

28366 ELECTRON TRAJECTORIES IN A NONUNIFORM AXIALLY SYMMETRIC MAGNETIC FIELD. D. A. Dunn and R. E. Holaday (Stanford Univ., Calif.). J. Appl. Phys., 32: 1612-20(Aug. 1961).

Electrons injected along the flux lines of a spatially varying, axially symmetric magnetic field that is increasing in the direction of electron motion will follow approximately helical trajectories about the flux lines. If the field increases too rapidly, the electrons will not be able to penetrate the magnetic field beyond a certain point and will be turned back by the magnetic mirror formed by the increasing field. For more slowly varying fields, the electrons can penetrate the mirror with a large fraction of their energy in axial velocity. The equations of motion for electrons in a sinusoidally varying magnetic field have been solved on a computer, and the results are presented in graphical form. An application of this field configuration as a device for converging a hollow cylindrical electron beam has been tested, and measured area convergences of 15 to 1 have been obtained by photographing a movable carbon screen collector that is heated by the beam. The beam is started out with a conventional parallel flow gun immersed in the magnetic field. As the beam leaves the first accelerating electrode it enters the region of increasing magnetic field. It then shrinks in diameter and thickness, and hence in area, approximately in proportion to the increase in the magnetic field. The actual area convergence will be less than this increase by an amount depending on the length and rate of the magnetic field taper. (auth)

28367 PLANE POLARIZATION OF 8.5 MEV BREMSSTRAHLUNG. Katsufusa Shoda (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 16: 1271-80(July 1961). (In English).

The polarization of bremsstrahlung produced by 8.5 Mev electrons incident on thin Al, Ag, Au, and U targets in a betatron was studied with D_2O-loaded nuclear emulsions. The polarization was measured at the characteristic emission angle $\Theta = mc^2/E_0$ by observing the azimuthal angular distribution of photoprotons from deuterons. The results show different energy dependence of polarization for different elements. For low Z targets the polarization is positive and large in the lower energy part of bremsstrahlung spectrum, in qualitative agreement with the theoretical calculations. For high Z targets the polarization is negative in the higher energy range and positive in the lower energy range. This reversal of the sign of polarization occurs at much lower energies than those expected from the theory. (auth)

28368 DOUBLE HYPERFRAGMENTS AND RELATIVE PARITY OF Λ AND Σ HYPERONS. Syurei Iwao (Syracuse Univ., N. Y.). Nuclear Phys., 26: 1-9(1961). (In English)

A method for the determination of the relative parity of Λ and Σ hyperons is proposed. The possible bound states of the double hyperfragments are predicted from the parameters obtained before. If the $\Lambda-\Lambda$ interaction is attractive in the singlet S state, Λ and Σ will have the same parity, otherwise the opposite parity. (auth)

28369 ON AN ISOBARIC SPIN SCHEME FOR LEPTONS AND THE LEPTONIC DECAYS OF STRANGE PARTICLES. Alladi Ramakrishnan (Univ. of Madras), A. P. Balachandran, N. R. Ranganathan, and N. G. Deshpande. Nuclear Phys., 26: 52-6(1961). (In English)

An isobaric spin scheme for leptons is discussed using the concept of missing components. A phenomenological set of rules is also suggested to explain the low rates of most of the $|\Delta S| = 1$ decays. (auth)

28370 SOME REMARKS ON GLOBAL SYMMETRY. Wojciech Królikowski (Inst. for Advanced Study, Princeton, N. J.). Nuclear Phys., 26: 91-6(1961). (In English)

According to Gell-Mann's original idea of global symmetry, K-meson interactions violate this symmetry. In the present paper, a speculative argument is described suggesting that all K-meson interactions must break down global symmetry and even restricted global symmetry (RGS). There exists, however, a kind of generalized RGS, for which this violation of RGS is more manifest in the real

K-meson processes than in the virtual ones. The argument presented connects the problem of RGS and its violation with the question why leptons do not interact strongly with pions and K-mesons. (auth)

28371 ELEMENTARY DERIVATION OF THE MINAMI PHASE SHIFT AMBIGUITY. R. Van Wageningen (State Univ., Groningen, Netherlands). Nuclear Phys., 26: 126-8 (1961). (In English)

An elementary derivation is presented of the Minami phase shift ambiguity in the analysis of elastic scattering of a spin $\frac{1}{2}$ particle by a spin 0 scattering center. (auth)

28372 ELASTIC AND INELASTIC SCATTERING OF NEUTRONS BY DEUTERONS NEAR THE INELASTIC THRESHOLD. L. M. Delves (Massachusetts Inst. of Tech., Cambridge). Nuclear Phys., 26: 136-46(1961). (In English)

A calculation is made of the neutron-deuteron s-wave elastic and inelastic scattering cross-sections which includes the interaction between these two channels. The scattering matrix given by this method is unitary. Comparison is made with a calculation of the elastic scattering using the same potentials but neglecting the effect of the inelastic channel. Large differences are found, indicating that it is important to include the deuteron distortion in elastic scattering calculations; however, this conclusion may be due at least partly to neglect of charge exchange scattering. The proton energy spectrum predicted by the model is the phase-space spectrum. This is identical with that of Frank and Gammel except near the upper end of the spectrum, where it agrees better with experiment at the energies considered. The size of the anomaly in the elastic scattering cross-section at the inelastic threshold is calculated, and found to be rather small. (auth)

28373 HIGH-VELOCITY RANGE AND ENERGY-LOSS MEASUREMENTS IN Al, Cu, Pb, U AND EMULSION. W. H. Barkas and S. von Friesen (Univ. of California, Berkeley). Nuovo cimento (10), 19: Suppl. No. 1, 41-62 (1961). (UCRL-8792). (In English)

Measurements were made of relative stopping powers of several materials in the proton energy intervals (750 – 600), (600 – 450), (450 – 300), and (750 – 0) Mev. By collimation and magnetic analysis a pencil beam free of degraded particles was extracted from the 184 in. cyclotron. Using this beam in good geometry the stopping powers of Al, Pb, U, and emulsion were measured relative to Cu. The total ranges yield accurate estimates of the mean excitation potentials. It is assumed that the mean excitation potential of Al is 163 ev, and that at 750 Mev substantially all the tight binding corrections required are those for the K and L shells. The other mean excitation potentials in ev are: copper, 323; lead, 826; uranium, 917; and emulsion, 328. The results from the differential stopping-power measurements are in general accord with these data. This experiment confirms the general shape of the I/Z vs Z curve found by Bakker and Segrè. The status of the emulsion range-energy table is reviewed in the light of these and other relevant measurements. Incidental observations were made on the scattering, straggling and attenuation behavior of a highly collimated monoenergetic beam of protons which was brought to rest in a large block of copper. (auth)

28374 A NOTE ON THE CAPTURE OF NEGATIVE MESONS IN PHOTOGRAPHIC NUCLEAR EMULSIONS. R. D. Hill (University Coll., London). Nuovo cimento (10), 19: Suppl. No. 1, 83-90(1961). (In English)

The slowing down of extremely low energy negatively charged mesons is discussed and range-energy curves are obtained. Based on these curves, an evaluation is made of the relative capture rates of negative mesons in light and heavy nuclei of photographic emulsions. These rates appear to be in very good agreement with experimental observations on the capture of negative μ mesons in nuclear emulsions. (auth)

28375 INELASTIC ELECTRON-DEUTERON SCATTERING CROSS SECTIONS AT HIGH ENERGIES. II. FINAL-STATE INTERACTIONS AND RELATIVISTIC CORRECTIONS. Loyal Durand, III (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 123: 1393-1422(Aug. 15, 1961). (BNL-5379)

Measurements of the cross section $d^2\sigma/(d\Omega_e dE_e')$ for the inelastic electron-deuteron scattering process $e + d \rightarrow e + n + p$ have been used to determine the electromagnetic structure of the neutron. The effects on the theoretical cross section of interactions between the outgoing nucleons are examined in detail using the methods of a previous paper. The transition matrix elements connecting the initial state of the two-nucleon system (the deuteron) to a final state with specified total, orbital, and spin angular momenta are calculated using approximate wave functions which are matched to the experimentally determined neutron-proton scattering phase shifts. While individual matrix elements may be drastically changed by the distortion of the final-state wave functions by the neutron-proton interaction, the over-all corrections to the peak value of the cross section are found to be small (−1 to −2%) for electron momentum transfers in the range $q = 3.4 - 2.6\ f^{-1}$. The precise magnitude of the corrections is somewhat uncertain because of the approximate nature of the wave functions, but it is unlikely either that they are large, or that the corrections could become positive. The effects of final-state interactions on the cross-section $d^2\sigma/(d\Omega_e dE_e')$ are also examined for final electron energies near the upper limit of the inelastic continuum. In this region, the nucleons emerge with low relative momenta, and, in agreement of the predictions of Jankus, the cross section is found to be drastically changed by the strong interactions in the final S states. However, it is shown that the presence in the neutron-proton interaction of a strongly repulsive core results in a considerable diminution of the cross section relative to the predictions of Jankus for large values of q. This lowering of the cross section has been observed by Kendall et al. Results obtained with approximate repulsive core wave functions provide a reasonable fit both to the inelastic cross section near the end point, and to the deuteron electromagnetic form factor obtained from elastic electron-deuteron scattering. Finally, the relativistic theory of inelastic electron-deuteron scattering is examined using the methods of dispersion relations. It is found that in the region of the large peak, the cross-section $d^2\sigma/(d\Omega_e dE_e')$ is given essentially correctly by a nonrelativistic calculation using a modified Hamiltonian, provided the results are interpreted correctly with respect to the kinematics. The approximations inherent in the calculation are examined in detail. The resulting cross section differs significantly from the modified Jankus cross section which has been used in the analysis of the high-energy electron-deuteron scattering data obtained by the Stanford group. It is found that the apparent values of the neutron charge form factor F_{1n} are reduced essentially to zero for q^2 in the range $5f^{-2} \leq q^2 \leq 20f^{-2}$ when relativistic corrections, the effects of the deuteron D-states cattering, and the effects of final-state interactions are taken into account. Corresponding reductions in the value of the neutron anomalous magnetic moment form factor F_{2n} range up to about 30%, and bring F_{2n} into closer agreement with F_{2p}. A complete re-analysis of the experimental data will be necessary. (auth)

28376 PHOTOPRODUCTION OF CHARGED π MESONS FROM NUCLEI. W. Melville McClelland (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 123: 1423-35(Aug. 15, 1961).

The photoproduction of charged π mesons by a 1000-Mev bremsstrahlung beam has been studied for the elements Be, C, Al, Cu, and Pb. Mesons with energies in the range 100 to 400 Mev emerging from the targets at angles of 58° and 115° were detected, and absolute measurements for the cross section are given. An optical model for the nucleus was employed to predict absolute upper and lower limits for the nuclear cross section, and reasonable agreement with the data was obtained. The measured cross sections had a dependence on the target atomic weight of $A^{3/4}$ and this result lay between the limits predicted by the model. The experimental nuclear π^-/π^+ ratio exhibited the general behavior of this quantity for deuterium, but the model could make no prediction here. The results seem to be consistent with an optical model treatment of an assumed initial production of mesons throughout the nuclear volume, and no recourse to a surface production mechanism was found to be necessary. (auth)

28377 CONVERSION OF MUONIUM INTO ANTIMUONIUM. G. Feinberg (Columbia Univ., New York) and S. Weinberg. Phys. Rev., 123: 1439-43(Aug. 15, 1961).

A detailed analysis is made of the possible conversion of muonium into antimuonium in various environments. An assumed $\bar{\mu}e\bar{\mu}e$ weak interaction of the usual form and strength gives a probability of 2.5×10^{-5} in vacuum, even in the presence of reasonable external electric fields. In a solid the probability is less by at least 10, and probably 20, orders of magnitude. In an inert gas the probability is roughly to be divided by the numbers of collisions during a muon lifetime, and hence is quite small unless the pressure at room temperature is less than about 10^{-4} atm. Lowering the temperature does not help. A possible experiment is suggested. (auth)

28378 ANGULAR DISTRIBUTION OF PROTONS FROM π^--p SCATTERING AT 900 MEV. Bogdan C. Maglić, Bernard T. Feld, and Carol A. Diffey (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 123: 1444-51(Aug. 15, 1961). (UCRL-9594)

The shape of the π^--p differential scattering cross section in the backward hemisphere should be sensitive to the nature of the "resonances" assumed to be responsible for the peaks in the total cross section at 600 and 900 Mev. The angular distribution of protons scattered in the forward hemisphere by pions of kinetic energy around 925 Mev, corresponding to pion c.m. angles from 65 deg to 150 deg, was obtained by placing nuclear emulsions close to liquid hydrogen and by measuring the direction angle and the grain count of every proton track. It is shown that the sensitivity of emulsions in the temperature region $22°K \leq T \leq 90°K$ does not drop below 85% of the sensitivity at 300°K. The resulting distribution is consistent with the assignment of $D_{3/2}^{1/2}$ and $F_{5/2}^{1/2}$, respectively, for the 600- and 900-Mev levels. (auth)

28379 s-WAVE PION-NUCLEON SCATTERING. Jack L. Uretsky (Purdue Univ., Lafayette, Indiana). Phys. Rev., 123: 1459-64(Aug. 15, 1961).

The Mandelstam relations for pion-nucleon scattering are used to obtain equations for the s-wave partial wave amplitudes in the two isotopic spin states. The solutions of these equations are investigated in the approximation where only the one-nucleon contributions and the unitarity integral are kept. It is found that there are no solutions of the form N/D without complex zeros, and that this is a consequence of the large size of the one-nucleon terms. A comparison with experiment is made which suggests that the dominant contribution to the $T = 3/2$ s-wave amplitude (other than the one-nucleon contribution) comes from a region of the complex energy plane that is outside the physical region for the related processes ($\pi-\pi$ into NN and "crossed" $\pi-N$ scattering). An appendix is devoted to discussing the available experimental data and they are found to be consistent with a scattering length (δ/k at threshold) of 0.098 ± 0.004 in the $T = 3/2$ state. (auth)

28380 PRODUCTION OF STRANGE PARTICLES IN p−p COLLISIONS AT 2.85 BEV. R. I. Louttit (Brookhaven National Lab., Upton, N. Y.), T. W. Morris, D. C. Rahm, R. R. Rau, A. M. Thorndike, W. J. Willis, and R. M. Lea. Phys. Rev., 123: 1465-71(Aug. 15, 1961). (BNL-5353)

From a sample of 98 hyperon production events observed in a liquid hydrogen bubble chamber the partial cross sections for various final states are found to be: $\Sigma^+K^+n - 0.047$, $\Sigma^+K^0p - 0.030$, $\Sigma^0K^+p - 0.013$, $\Lambda^0K^+p - 0.051$, $\Sigma^-K^+p\pi^+ - 0.003$, $\Sigma^+KN_\pi - 0.004$, $(\Lambda^0\Sigma^0)K^+p\pi^0 - 0.011$, $(\Lambda^0\Sigma^0)K^0p\pi^+ - 0.014$, $(\Lambda^0\Sigma^0)K^+n\pi^+ - 0.002$, all in millibarns. For the first four processes the values are in general agreement with those calculated by Ferrari using a one-pion-exchange model. Only one example of K-pair production was observed, indicating a cross section less than 0.01 mb. (auth)

28381 THEORY OF π-N SCATTERING IN THE STRIP APPROXIMATION TO THE MANDELSTAM REPRESENTATION. Virendra Singh and B. M. Udgaonkar (Univ. of California, Berkeley). Phys. Rev., 123: 1487-95(Aug. 15, 1961). (UCRL-9561)

The strip approximation to the Mandelstam representation is applied to the $\pi-N$ problem, and the basic equations given. The asymptotic behavior of the invariant amplitudes in the physical regions is discussed in terms of the unitarity condition on partial-wave amplitudes, the constancy of high-energy scattering cross sections, and the Pomeranchuk theorem, and it is shown to imply that no subtractions should be necessary except in the $J = 1/2$ wave of the $\pi-N$ channel and the $J = 0$ wave of the $\pi + \pi \rightharpoonup N + N$ channel. This obviates the difficulties encountered by earlier workers when they subtracted higher waves. (auth)

28382 TRANSFER OF HELICITY IN RADIATION AND ABSORPTION OF HIGH-ENERGY PHOTONS. R. H. Pratt (Stanford Univ., Calif.). Phys. Rev., 123: 1508-10(Aug. 15, 1961).

Nearly complete transfer of momentum between a high-energy electron (or positron) and a photon in a Coulomb field implies that helicity is also transferred. This is not a consequence of conservation of total angular momentum but, rather, of spin angular momentum, and follows from a demonstration that it is possible to use free-particle spinors (though not free wave functions) for the high-energy particles. Polarization correlations of the lower energy particle in such a process are discussed. Applications are made to bremsstrahlung, pair production, photoeffect, and one-photon pair annihilation. (auth)

28383 P-WAVE RESONANCE IN PION-PION SCATTERING. Miwae Yamazaki (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 25: 727-34(May 1961). (In English)

Pion-pion scattering in the $I = l = 1$ state is treated by the Tamm-Dancoff method. By making an approximation in which configurations containing up to three particles of meson and nucleon pair are taken into account in the 4th order pion-pion interaction kernel, the existence of resonance is concluded. By adjusting the coupling constant $g^2/4\pi$ between pion and nucleon so as to fit the pion-pion scattering length $a = 0.1 \sim 0.3\ \mu^{-3}$ in the $I = l = 1$ state, the reso-

nance level of 600 ~ 400 Mev and resonance width of 140 ~ 40 Mev is found, which is quite consistent with that adopted by Takeda et al. in their theory of the 2nd ~ 3rd maximum in pion-nucleon scattering and also by Frazer-Fulco in the explanation of isotopic vector magnetic form factor of a nucleon. The relation $g^2/4\pi = 6.1 \sim 6.8$, which is somewhat smaller than the conventional one, is adopted. This small coupling constant is interpreted as due to the inclusion of the effects of scattering and annihilation of a virtual nucleon pair. (auth)

28384 DISPERSION RELATIONS FOR KAON-NUCLEON SCATTERING AND KK$\pi\pi$ INTERACTION. Keiji Igi (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 25: 753-79(May 1961). (In English)

A general formalism is given in order to investigate the type of the K-Λ-nucleon and K-Σ-nucleon couplings together with the KK$\pi\pi$ interaction by applying the Cini-Fubini approximation to the Mandelstam representation for the K-nucleon scattering. By taking suitable combinations of invariant amplitudes for $K^{\pm}$-p and $K^{\pm}$-n, the effects due to the isospin independent and dependent type of the KK$\pi\pi$ interaction can be isolated. Necessary experimental data which make the independent determination of these coupling types possible are suggested. In particular, a simple method is discussed which allows a determination of the isospin dependent KK$\pi\pi$ interaction, and then a suitable experiment for it is proposed. (auth)

28385 LOW-ENERGY LIMIT THEOREMS AND DISPERSION RELATIONS. Ken Kawarabayashi (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 25: 780-96(May 1961). (In English)

Low-energy limit behavior of various collision processes is re-investigated from the dispersion theoretic point of view, which turns out to be a powerful approach for obtaining low-energy limit theorems. Some low-energy limit theorems for the processes involving collisions of a boson with a fermion are obtained, using this method. It is shown that for pion-baryon scattering, certain isotopic spin combinations of the P-wave spin-flip amplitudes satisfy simple low-energy limit theorems. In particular, for pion-nucleon scattering, isotopic even part of the P-wave spin-flip amplitude is shown to be simply related to the renormalized pion-nucleon coupling constant, from which the magnitude of the coupling constant can be determined: $f^2/4\pi = 0.09 \pm 0.02$. It is also shown that this determination is insensitive to the presence of (3,3) resonance and a possible T = J = 1 pion-pion resonance. (auth)

28386 THE EFFECT OF THE PION-PION INTERACTION ON THE PION-NUCLEON SCATTERING. Kin-ichi Ishida (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 797-802(May 1961). (In English)

It is suggested that the low-energy pion-nucleon p-wave shifts will be well understood by taking account of the effects of not only the pion-pion P-wave interaction but also the pion-pion S-wave interaction into the equations for the p-wave scattering amplitudes derived by Chew, Goldberger, Low, and Nambu. (auth)

28387 COMMENTS ON FERMI'S STATISTICAL THEORY OF HIGH ENERGY NUCLEAR EVENTS. K. B. Fenton (Univ. of Tasmania, Hobart, Australia). Progr. Theoret. Phys. (Kyoto), 25: 842-3(May 1961). (In English)

Minor errors in Fermi's paper and McConnell's article on pion and nucleon-antinucleon pair production in high-energy interactions are pointed out. The correction indicates twice as many nucleons and antinucleons as π mesons, whereas Fermi's estimate of n_N was too large by about 16%. McConnell's article includes this error and in addition states that $W^1 = 2W^2/Mc^2$ for the total energy in the laboratory system. The correct expression is $W^1 = W^2/2Mc^2$. (L.N.N.)

28388 MASS OF A NEUTRAL VECTOR MESON AND p-p SCATTERING. Shoroku Ohnuma (Waseda Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 25: 847-9(May 1961). (In English)

It is shown that Sakurai's approach based on Chew's conjecture on one pion singularities contains a difficulty in explaining the energy dependence of Wolfenstein's amplitude (C) at $\theta = 90°$ (θ is the pp scattering angle) if the mass of the neutral vector meson is fixed by the angular dependence of C. It is graphically shown that Sakurai's equation will not produce satisfactory results. The neutral vector meson proposed must not be considered as the only qualitative explanation of the spin-orbit interactions between two nucleons even if the neglect of the wave function distortion turned out to be justifiable. (See NSA 14: 24793.) (L.N.N.)

28389 WEAK INTERACTIONS AT HIGH ENERGIES. Kanji Fujii, Hideaki Nagai, Tetsurô Sakuma, and Tetsuya Tsuchida (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 25: 849-51(May 1961). (In English)

Muon production in high-energy nucleon interaction was investigated by the recently developed "peripheral interaction model" (See NSA 14: 14313), and the results are tabulated. Anomalous production of leptons by nucleon interactions could scarcely be found, so far as the perturbational treatment was admitted, although this might be altered if many-particle exchange contribution dominates in the high-energy region. (L.N.N.)

28390 TWO-NUCLEON SPIN-ORBIT FORCES AND THE DOUBLET SPLITTING IN LOW ENERGY n-α SCATTERING. Yasuo Takamura and Ryozo Tamagaki (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 25: 855-8 (May 1961). (In English)

Doublet splitting in neutron-alpha reactions is investigated to study spin-orbit forces at low energies (less than 100 Mev). The pion theory of nuclear forces is used to predict spin-orbit forces as a part of two-pion-exchange potential. Other origins are possible, and the conditions to be imposed on strong spin-orbit effects are clarified by phenomenological analyses. It is found that the strong spin-orbit forces playing an important role at high energies become weaker at low energies, and therefore it is not appropriate to describe such effects of two-nucleon spin-orbit coupling beside the spin-orbit potential of two-pion-exchange potential by spin-orbit potentials. (L.N.N.)

28391 AN ISOBARIC STATE K* IN K-π SYSTEM AND $p + \bar{p} \rightarrow K + K + \pi + \pi$ PROCESS. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 25: 861-3(May 1961). (In English)

The isobaric state $\bar{K}^*$ can be investigated by obtaining experimental data for energy spectra of nucleons in the reaction $K + N \rightarrow K + \pi + N$. The reaction $p + \bar{p} \rightarrow K + \bar{K} + \pi + \pi$ would be measured. It is assumed that the reaction takes place mainly through the process $p + \bar{p} \rightarrow K^* + \bar{K}^* \rightarrow K + \bar{K} + \pi + \pi$. Branching ratios are estimated and tabulated. (L.N.N.)

28392 K MESON-NUCLEON INTERACTION AT HIGH ENERGY. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 25: 863-5(May 1961). (In English)

K meson-nucleon scattering processes at high energies are discussed in terms of long-range $\bar{K} - N$ or $K - N$ interactions caused by two-pion exchanges on which the K* has an important effect. The process $\bar{K} + N \rightarrow K^* + N^* \rightarrow \bar{K} +$

$\pi + \pi + N$ or $K + N \rightarrow \bar{K}^* + N^* \rightarrow K + \pi + \pi + N$ is considered and the case $I_{K^*} = 3/2$ is discussed. (L.N.N.)

28393 THE γ^+-DECAY AND THE BOSON ISOBAR WITH I = 2 OF THE SAKATA MODEL. Shoji Sawada, Tamotsu Ueda, and Minoru Yonezawa (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 25: 868-70(May 1961). (In English)

The problem of deviation from the theoretical spectrum for spinless K mesons in the 3π decay process is studied by considering the effect of the $B_{\frac{1}{2}}(0,2)$ which corresponded to the strong π-π interaction. The expressions for π^- and π^+ spectra in τ^+ decay and for the π^+ spectrum in $\tau^{+\prime}$ decay are developed and data are presented graphically. (L.N.N.)

28394 A NOTE ON BARYON-BARYON INTERACTION. G. Bhamathi, S. Indumathi, T. K. Radha, and R. Thunga (Univ. of Madras). Progr. Theoret. Phys. (Kyoto), 25: 870-2(May 1961). (In English)

The process of a (Ξ^- n) collision giving rise to hyperon systems is studied, the possibility of a bound state in the final system being also envisaged. The implication arising from the various parity assignments for the hyperons is discussed and the decay distribution of the possible bound system is analyzed. (L.N.N.)

28395 THE SINGLE PION PRODUCTION PROCESS IN π^-p COLLISION AT 1 Bev AND THE SAKATA MODEL. Shoji Sawada, Tamotsu Ueda, and Minoru Yonezawa (Hiroshima Univ.). Progr. Theoret Phys. (Kyoto), 25: 873-87(June 1961). (In English)

An analysis is made of the experimental data of Derado and Schmitz on the single pion production process in π^--p collision at 1 Bev by the generalized isobar model. The isobar model used is a generalization of the Lindenbaum and Sternheimer 3-3 nucleon isobar model. But the standpoint is based on the Sakata model and all the possible fermion and boson states of the full symmetry theory are taken into account. It is shown that this generalized isobar model can well explain the experimental momentum spectra. The evidences of boson isobars of I = 2 with mass ~400 Mev and I = 1 with mass ~650 Mev are suggested from the analysis of the D-S data. (auth)

28396 THE COMPOSITE MODEL OF MESONS AS A LIMIT OF MESON THEORY. Yasusi Ataka (Kinki Univ., Osaka). Progr. Theoret. Phys. (Kyoto), 25: 895-900 (June 1961). (In English)

In meson theory with local interactions, the probability amplitudes for bare mesons vanish in the limit of infinite bare coupling constant $g \rightarrow \infty$ and infinite bare meson mass $\mu \rightarrow \infty$, where g/μ remains finite. Then the probability amplitude for no meson state satisfies the same eigenvalue equation as the composite model with local Fermi interactions, whose coupling constant is $G = \frac{1}{2}\bar{g}^2$. The physical meaning of such a procedure and the results thus obtained are discussed. (auth)

28397 INTERNAL DEGREES OF FREEDOM AND ELEMENTARY PARTICLES. [PART] I. Takehiko Takabayasi (Univ. of Nagoya, Japan). Progr. Theoret. Phys. (Kyoto), 25: 901-38(June 1961). (In English)

Quantum theory of point-like systems is established by extending the concept of relativistic particle in some respects: A point-like system means a one-parameter series of events $x_\mu(\tau)$ with substantial internal degrees of freedom concentrated upon x_μ, and indefinite metric in Hilbert space is generally taken as to the internal degrees. The theory corresponds to an extension of the usual local field equations, suitable to obtaining a unified theory of elementary particles. The rest-mass, $m^2 = -p_\mu^2$ (with p_μ as momentum-energy vector) becomes a dynamical quantity of the system with its possible eigenspectrum, leading to uncertainty relations between rest mass value and space-time localization. The internal angular momentum tensor $S_{\mu\nu}$ is another basic dynamical quantity of the system and is responsible for spin and Zitterbewegung. Also defined is the instantaneous velocity operator ν_μ, which is not generally colinear with p_μ and must be restricted by certain kinematical conditions. Three different criteria about these conditions on ν_μ make point-like systems classified into various types. For "normal class" of systems, $\rho \equiv -\nu_\mu^2$ is an absolute invariant with eigenvalue 1 or 0 and is regarded to represent baryon number. Especially important are point-like systems of the first kind, i.e., the ones in which ν_μ commute with the position x_μ and thus mean internal variables. Such a system generally has, besides rest mass, spin and ρ, three self-adjoint commuting invariant quantities formed out of ρ_μ, ν_μ and $S_{\mu\nu}$ only, which are to be identified eventually with the intrinsic properties of elementary particles (isospin, hypercharge, etc.). Systems are further divided into "classical models," where velocity components are commutable (an example being relativistic rotator), and "non-classical models" where they are not ($[\nu_\mu, \nu_\nu] \neq 0$), to derive general characteristics for each of them. Dirac and Kemmer particles are special simple examples of the latter, where system has no substantial internal degrees of freedom apart from ν_μ. (auth)

28398 DISPERSION RELATIONS FOR VIRTUAL PION-NUCLEON SCATTERING. J. Iizuka and A. Klein (Univ. of Pennsylvania, Philadelphia). Progr. Theoret. Phys. (Kyoto), 25: 1017-27(June 1961). (In English)

In connection with a proposed calculation of single pion production in nucleon-nucleon collisions, the process of pion-nucleon scattering in which the incoming pion is virtual is investigated by means of the dispersion theoretic method developed by Chew, Goldberger, Low and Nambu. The static limit is studied in detail and the Chew-Low amplitude for virtual scattering is shown to result for small virtual pion masses. More generally, it is proposed that the Blankenbecler-Gartenhaus solution, which is recorded, may provide a useful approach in applications in which large virtual pion masses play an essential role. (auth)

28399 THE Σ-Λ RELATIVE PARITY AND THE $\bar{K}$-N REACTION. [PART] II. Yukihisa Nogami (Univ. of Osaka Prefecture, Sakai, Japan). Progr. Theoret. Phys. (Kyoto), 25: 1028-34(June 1961). (In English)

According to Dalitz and Tuan's phenomenological analysis of K^--p reactions the recently discovered π-Λ resonance $\bar{K}$ may be interpreted as caused by the existence of a quasi-bound state of $\bar{K}$-N which decays into π-Λ. It is conjectured that the K-Λ (K-Σ) parity relative to N is odd (even) and hence the Σ-Λ relative parity is odd. Arguments for our conjecture are given concerning branching ratios of the decay of the quasi-bound state and also of the hyperon production in the K^--p absorption near the threshold. (auth)

28400 SCATTERING OF SLOW PARTICLES IN NUCLEAR EMULSIONS. E. Fridlender (Inst. of Nuclear Physics, Rumania). Rev. phys., Acad. rep. populaire Roumaine, 5: 355-65(1960). (In Russian)

Effective cross sections for low-energy π meson interactions were studied by analyzing the distribution of π orientations at the end of tracks. The total effect of Coulomb scattering, multiple scattering, and nuclear scattering is calculated. (R.V.J.)

28401 PRODUCTION OF Y^0 (Λ,Σ^0) AND K^0-PARTICLES ON LIGHT NUCLEI BY 2.8 BeV/c π^--MESONS. Ya. Ya.

Shalamov, V. A. Shebanov, and A. F. Grashin (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1302-12 (May 1961). (In Russian)

The production of $Y^0(\Lambda,\Sigma^0)$ hyperons and K^0 mesons by 2.8 Bev/c π^- mesons on light nuclei was studied in a freon ($C_2F_5Cl_3$) bubble chamber. The Y^0 and K^0 production cross sections are respectively (2.5 ± 0.5) and (7 ± 1)% of the total cross section for inelastic processes. From 143 ($Y^0 + K^0$) and ($K^0 + \overline{K}^0$) production events the cross sections were determined as well as the angular and momentum distributions. The ratio of the cross sections is $\sigma(K^0\overline{K}^0)/\sigma(Y^0K^0)$ = 0.35 ± 0.15 and their sum is $\sigma(K^0\overline{K}^0) + \sigma(Y^0K^0)$ = (3.2 ± 0.8)% of the total cross section for inelastic processes. In 80 to 90% of the events an elementary $Y^0 + K^0$ production act is accompanied by the generation of a π meson but in 70 to 80% of $K^0 + \overline{K}^0$ production events no additional π meson is emitted. A characteristic feature is that in $K^0 + \overline{K}^0$ production the K^0 carries off practically all the available energy, whereas a soft hyperon spectrum is observed in $Y^0 + K^0$ production. The cross sections for the reactions $\pi^- + \pi^+ \rightarrow K^0 + \overline{K}^0$ ($\sigma \sim 2$ mb) and $\pi^- + K^{0,+} \rightarrow \overline{\pi}^{-,0} + K^0$ ($\sigma \gtrsim 10$ mb) can be estimated for final particle kinetic energies in the cms $\leq$0.5 Bev by assuming that in the reactions under consideration, pole diagrams yield a large contribution. (auth)

28402 INTERACTION OF π-MESONS IN THE FERMI STATISTICAL THEORY. V. S. Barashenkov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1313-15(May 1961). (In Russian)

The energy spectra of π mesons and nucleons produced in inelastic N–N collisions at an energy E = 9 Bev are calculated under the assumption of π–π interaction. The results of the calculations are compared with the experiments. (auth)

28403 NUCLEON–NUCLEON INTERACTIONS AT E ≈ 10^{11}ev ENERGY. I. M. Dremin and D. S. Chernavskii (Lebedev Inst. of Physics, [Moscow]). Zhur. Eksptl'. i Teoret. Fiz., 40: 1333-7(May 1961). (In Russian)

Peripheral nucleon–nucleon collisions at E ≈ 10^{11} ev are examined. The analysis is carried out in the pole approximation and the results are compared with published experimental data. The single meson approximation in the usually applied form is found to be invalid for large virtuality values, k^2(k is the 4-momentum of the intermediate π meson) and requires improvement. The dependence of the π–N interaction cross section on k^2 should be taken into account. (tr-auth)

28404 PHASE ANALYSIS OF pp-SCATTERING AT AN ENERGY OF 150 Mev. I. M. Gelfand, A. F. Grashin, and L. N. Ivanova. Zhur. Eksptl'. i Teoret. Fiz., 40: 1338-42 (May 1961). (In Russian)

A nine parameter phase analysis (in which the single meson "tail" is taken into account) is applied to the experimental data on 150 Mev p–p scattering (the cross section, polarization, depolarization and rotation of polarization) by a new numerical method (the "ravine" method). Two distinct solution regions are obtained which are similar to those previously obtained for 95 Mev. The solution found by Stabler and Lomon, Nuovo Cim., 15, 150, 1960, lies in one of the regions. The results are compared with the theoretical calculation for peripheral phase shifts. (auth)

28405 ON NONLINEAR QUANTIZATION OF A SPINOR EQUATION. D. S. Chernavskii (Lebedev Inst. of Physics, [Moscow]). Zhur. Eksptl'. i Teoret. Fiz., 40: 1360-5(May 1961). (In Russian)

A nonlinear spinor equation of the Heisenberg type is considered. A procedure for determining the mass values of the eigenstates of the spinor field is proposed which is based on assumptions that: the number of entrance and exit lines on the diagrams describing eigenstates of the field are sufficiently large and only irreducible diagrams are taken into account. The procedure is carried out by means of the self-consistent field method. (auth)

28406 RELATIVISTIC GENERAL THEORY OF REACTIONS OF THE a + b → c + d + e + ... TYPE. M. I. Shirokov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1387-91(May 1961). (In Russian)

A relativistic theory of reactions with three or more product particles is developed. It is a generalization of the relativistic theory of reactions of the a + b → c + d type in the Jacob, Wick, and Chou Kuang-chao form. It was found that in this case other variables should be used as the relative particle momenta instead of the Jacob variables. Selection rules for such reactions which can be deduced from parity conservation are presented. (auth)

28407 THE PARTICLE MASS IN THE ONE-DIMENSIONAL MODEL WITH FOUR-FERMION COUPLING. V. G. Vaks and A. I. Larkin. Zhur. Eksptl'. i Teoret. Fiz., 40: 1392-8(May 1961). (In Russian)

Superconductivity theory is used for determining the particle mass in renormalized theories without a bare mass and involving a weak coupling constant. Only a zero solution for the mass exists in electrodynamics and the one-dimensional Thirring model. A nonzero solution was found in the one-dimensional model of two interacting fields. A finite expression for the charge was obtained for this model. (auth)

28408 DEPOLARIZATION OF μ^+–MESONS AND POLARIZATION OF Σ^+–PARTICLES IN A MAGNETIZED PARAMAGNETIC GAS. A. M. Perelomov. Zhur. Eksptl'. i Teoret. Fiz., 40: 1418-22(May 1961). (In Russian)

A formula is derived for the degree of depolarization of polarized μ^+ mesons in a paramagnetic gas located in a magnetic field. Exchange of electrons between the gas atoms and μ^+e^- atom is taken into account. The degree of depolarization depends on the fraction of μ^+ mesons capturing electrons, on the probability of electron exchange, and on the magnetic field strength. The degree of polarization in a paramagnetic gas of Σ^+ particles which initially are unpolarized is also computed. (auth)

28409 QUASICLASSICAL PARTICLES IN A ONE-DIMENSIONAL PERIODIC POTENTIAL FIELD. A. M. Dykhne (Inst. of Radiophysics and Electronics., Siberian Branch of the Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1423-6(May 1961). (In Russian)

The widths of the energy gaps in the spectrum of a quasiclassical particle located in a one-dimensional periodic potential are calculated. The widths are found to be exponentially small. The pre-exponential factor and the energy spectrum near the band edges are determined. (auth)

28410 TWISTED SPACE AND NONLINEAR FIELD EQUATIONS. V. I. Rodichev (Moscow District Pedagogical Inst.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1469-72(May 1961). (In Russian)

It is shown that in twisted space the nonlinear spinor equations considered in the field theory of elementary particles can be derived from a variational principle in which the Dirac Lagrangian is supplemented by a scalar space curvature. (auth)

28411 REMARKS ON $\pi\Lambda$–RESONANCE. A. L. Lyubimov (Joint Inst. for Nuclear Research, Dubna, USSR).

Zhur. Eksptl'. i Teoret. Fiz., 40: 1520-2(May 1961). (In Russian)

Phenomenological analysis of K^- interactions on protons, considering only purely S states, indicated that with the virtual K^-–p scattering amplitude the non-physical part corresponds to π–hyperon resonance. However, investigations of the interference of K^- Coulomb and nuclear scattering on protons tends to postulate that the interference is of a positive character. In this case, π–hyperon resonance corresponding to K^-–p S-state interaction cannot be present and the observed $\pi-\Lambda$ resonance is P-state. The analogy of P-state $\pi-\Lambda$ resonance and π–N resonance (at $^3/_2,^3/_2$) is discussed. (R.V.J.)

28412 SEEKING NEAR-THRESHOLD ANOMALIES IN THE ENERGY DEPENDENCE OF THE TOTAL PROTON INTERACTION CROSS SECTIONS. I. M. Vasilevskii, Yu. D. Prokoshkin and V. I. Rykalin (Joint Inst. for Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1524-5 (May 1961). (In Russian)

An analysis is made of anomalies found in the vicinity of the threshold of π meson pair production in proton interactions (580 to 600 Mev). The energy dependence of the total proton interaction cross section was also studied in regions below and above the thresholds. The magnitudes of $\sigma(E) - \bar{\sigma}(E)\bar{\sigma}(E)$ are plotted as functions of proton energy, and the thresholds of $pp \rightarrow pp\pi^0\pi$, $pp \rightarrow d\pi^0\pi^+$, $pp \rightarrow pn\pi^0\pi^+$, $pp \rightarrow pp\pi^+\pi^-$, and $pp \rightarrow nn\pi^+\pi^+$ are given. The region 490 to 640 Mev exhibited no anomalies in the energy dependence of the total p–p interaction cross section. Hence, it is postulated that a π–N binding state with binding energy near zero is not probable. (R.V.J.)

28413 CROSS SECTION RELATION OF $\pi N \rightarrow \pi\pi N$ REACTION AT 290 Mev AND $\pi\pi$ INTERACTION. Yu. A. Batusov, S. A. Bunyatov, V. M. Sidorov, and V. A. Yarba (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1528-30(May 1961). (In Russian)

Studies of the relation between the cross sections of $\pi N \rightarrow \pi\pi N$ reactions at 290 Mev indicate that π mesons interact between themselves mostly in isotopic spin $T_\pi = 0$. Consequently, the transitions of the ground state $T = {}^1/_2$ are the main contributors to the inelastic cross sections at energies less than 300 Mev. The obtained data contradict the postulation on resonance two-π interaction at a total energy of 310 ± 10 Mev and with isotopic spin $T_\pi = 1$. The interaction of $T_\pi = 0$ was prevalent and no resonance is indicated. (R.V.J.)

28414 THE TOTAL CROSS SECTIONS FOR INTERACTION BETWEEN 4.75 AND 3.7 Bev/c K^+ AND π^+–MESONS WITH PROTONS AND NUCLEI. M. F. Likhachev, V. S. Stavinskii, Hsu Yung-Chang, Chang Nai-sen (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 38-41(July 1961). (In Russian)

The total cross sections for K^+ and π^+ meson interactions with protons were measured. The following values were obtained: 21.3 ± 4.6 and 21 ± 4.3 mb for K^+ mesons and 33.3 ± 1.3 and 30 ± 1.2 mb for π^+ mesons, the momenta respectively being 4.75 ± 0.15 and 3.7 ± 0.1 Bev/c. Data on the cross sections for inelastic collisions between K^+ and π^+ mesons with various nuclei have also been obtained. (auth)

28415 BACKWARD ELASTIC SCATTERING OF 2.8 Bev/c π^-–MESONS ON NEUTRONS. Yu. D. Bayukov, G. A. Leksin, D. A. Suchkov, Ya. Ya. Shalamov, and V. A. Shebanov (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 52-5 (July 1961). (In Russian)

Quasielastic π^--n scattering toward the rear hemisphere in the laboratory system was investigated in a 17 liter freon chamber. The cross section of the process per F nucleus was found to be <0.1 mb. Recalculated for a free nucleon the total π-n elastic scattering cross section is found to be smaller than 0.02 mb for angles between 140 and 180° in the cms. Comparison of this result with the theoretical estimations of the contribution of a single virtual nucleon diagram to the scattering indicates that the diagram is compensated by more complex diagrams. (auth)

28416 CORRELATION BETWEEN THE NORMAL POLARIZATION COMPONENTS IN THE pp-SCATTERING FOR THE ENERGY OF 650 Mev. [PART] I. B. M. Golovin, V. P. Dzhelepov, R. Ya. Zulkarneev (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 83-8(July 1961). (In Russian)

In correspondence with the program of conducting the complete set of experiments for the determination of nucleon–nucleon scattering amplitudes, the correlation coefficient between the normal polarization components (the parameter C_{nn}) was measured for the scattering angle 90° (cms) in elastic p–p scattering at 650 Mev. The value $C_{nn}(90°) = 0.93 \pm 0.19$ was found. On the basis of the obtained values the modulae of the respective amplitudes in the scattering matrix are calculated. (auth)

28417 ANGULAR DISTRIBUTION OF μ-MESONS IN π-μ-DECAY. A. O. Vaisenberg, E. D. Kolganova, and Z. V. Minervina (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 106-8(July 1961). (In Russian)

It is shown that the angular distribution of μ mesons emitted in the decay of π mesons produced in strong interactions is isotropic. Deviations from isotropy observed in certain cases may be due to omission of some of the $\pi-\mu$-decays when their density is very high. Emulsion and microscope distortions are shown to have no effect on the angular distribution. (auth)

28418 LIMITING VALUES OF THE $\pi^\pm$ p-SCATTERING AMPLITUDE. V. P. Kanavets, I. I. Levintov, and B. V. Morozov (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 146-53(July 1961). (In Russian)

Dispersion relations in which subtraction is transferred to points located at infinity are derived on the basis of the Pomeranchuk assumptions regarding the asymptotic behavior of the scattering amplitude. In this form the dispersion relations are most convenient for estimating the asymptotic behavior of the amplitude on basis of the experimental data on $\pi^\pm$–p scattering. A preliminary numerical estimation of the asymptotic behavior of the π^-p scattering amplitude is presented. The question whether validity of the dispersion equations at high energies is consistent with the statistical theory is considered. (auth)

28419 DETERMINATION OF THE π-MESON-NUCLEON COUPLING CONSTANT FROM THE DIFFERENTIAL CROSS SECTIONS FOR ELASTIC pp-SCATTERING. Yu. M. Kazarinov, V. S. Kiselev, I. N. Silin, and S. N. Sokolov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 197-8(July 1961). (In Russian)

The p-p scattering cross sections at energies of 147, 330, and 380 Mev are employed for determining the π-N coupling constant f^2. The results obtained for $E_p = 137$ and 380 Mev are consistent with a value of $f^2 = 0.08$. It is not possible to make the cross section at 330 Mev agree with the value $f^2 = 0.08$. (auth)

28420 ON THE $K^+ \rightarrow \pi^+ - \pi^0 + e^+ + e^-$ DECAY. I. G. Ivanter (Inst. of Scientific Information, Academy of Sci-

ences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 244-6 (July 1961). (In Russian)

The $K^+ \rightarrow \pi^+ + \pi^0 + e^+ + e^-$ decay is considered without taking into account interaction after decay. The distributions in the effective mass of the two π-meson system are derived. A new approximate method has been applied to compute the integrals of the bremsstrahlung probabiltiy density over phase space in the presence of two very light particles among the four. (auth)

28421 INTEGRAL EQUATIONS FOR $\pi\pi$-SCATTERING AND PROBLEMS RELATED TO CONVERGENCE OF THE AMPLITUDE EXPANSION. Ya. Fischer and S. Chulli (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 256-62(July 1961). (In Russian)

Convergence of the expansion of the cosine dependence of the amplitude employed in the deduction of the integral equations from the Mandelstam representation is investigated in the case of π-π scattering. An equation set for low energies is presented in which rapid convergence of the expansion of the real part of the amplitude can be attained by a conformal mapping of the cosine plane. Since any power of the function employed contains an infinite number of partial waves this approach should be especially convenient in those cases when high number waves may be important. (auth)

28422 SINGLE MESON CONTRIBUTION TO PHOTOPRODUCTION OF π^--MESONS ON PROTONS. L. V. Laperashvili and S. G. Matinyan (Inst. of Physics, Academy of Sciences, Georgian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 272-5(July 1961). (In Russian)

Quantitative agreement between Drell's theory and experiments on photoproduction of negative π mesons on protons can be obtained by taking into account the correction suggested by Salzman's. (auth)

28423 ON THE ROLE OF THE SINGLE-MESON POLE DIAGRAM IN SCATTERING OF γ-QUANTA BY PROTONS. L. I. Lapidus and Kuang-chao Chou (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 294-302(July 1961). (In Russian)

It is shown that with the right choice of sign for the γ-N scattering diagram pole related to π^0 decay, its contribution to the cross section for γ-p scattering decreases considerably. In order to obtain information on the lifetime of the π^0 meson the precision of the experiments should be appreciably better improved. (auth)

28424 ON THEORY OF MESON WITH THEORY OF ELECTRON. Nagatoshi Tunazima. Tokyo, Sanshusha Press, 1961. 106p.

A theory of nuclear forces and structures is developed, in which electrons (+ and −) and mesons play important roles. Nucleons are assumed to be agglomerations of electrons (+ and −), and mesons are assumed to be excited states of electrons (+ and −). The properties of neutrinos in this theory are derived. The theory is developed in the framework of general relativity. (T.F.H.)

Neutron Physics

28425 (AGN-TM-392) 2 D X Y — TWO DIMENSIONAL, CARTESIAN COORDINATE S_n TRANSPORT CALCULATION. Army Gas-Cooled Reactor Systems Program. J. Bengston, S. T. Perkins, T. W. Sheheen, and D. W. Thompson (Aerojet-General Nucleonics, San Ramon, Calif.). June 1961. Contract AT(10-1)-880. 64p.

A 2DXY program is presented that solves the multigroup discrete neutron transport equations, with isotropic scattering in two dimensional Cartesian coordinates. The surface boundary conditions are either zero inward flow or perfect reflection. An isotropic boundary source or an isotropic volume source may be specified in the inhomogeneous calculation. In the homogeneous problem, the eigenvalue may be reactivity, exponential rate, concentration, or unilateral zonal (or uniform) expansion. (auth)

28426 (GA-1803) ROBESPIERRE: A PROGRAM FOR CALCULATING THE NELKIN SCATTERING KERNEL FOR BOUND HYDROGEN. D. H. Perkel (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Aug. 1, 1961. Contract AT(04-3)-167. 26p.

ROBESPIERRE is a FORTRAN-II program for calculating the thermal-neutron scattering-kernel matrices for bound hydrogen, according to Nelkin's formulation. The program computes $\sigma(E \rightarrow E', \mu)/\sigma_0$ for a set of input energies and angles, and integrates, using input weighting factors, to evaluate the P_0, P_1, P_2, and P_3 energy-transfer matrices. The off-line output cards are in a format suitable for input to the other FORTRAN programs developed for neutron-thermalization studies. ROBESPIERRE allows two oscillators to be excited simultaneously, and provides for the inclusion of an asymptotic-expansion correction term, in Hermite polynomials up to order six. The upper and lower limits of the summation are calculated algebraically before the terms are evaluated, assuring convergence and eliminating certain underflow problems that were encountered in earlier programs for calculating the hydrogen kernel. ROBESPIERRE also incorporates a new subroutine for evaluating Bessel functions. (auth)

28427 (GA-2156) LEGENDRE EXPANSION COEFFICIENTS FOR THE ANGULAR DISTRIBUTION OF ELASTICALLY SCATTERED NEUTRONS AND FAST-NEUTRON CROSS SECTIONS FOR DEUTERIUM, BERYLLIUM, CARBON, OXYGEN, ZIRCONIUM, LEAD, AND BISMUTH. G. D. Joanou, A. J. Goodjohn, and N. F. Wikner (General Atomic Div., General Dynamics Corp., San Diego, Calif.). May 15, 1961. Contract AT(04-3)-314. 79p.

An analysis was made of experimentally determined angular distributions for elastically scattered neutrons in terms of Legendre polynomial expansion coefficients. The first six coefficients of the expansion were calculated as a function of energy from 0.1 to 14.0 Mev. In addition to the tabulated results, the procedures used in obtaining the coefficients and the cross-section data for each element are discussed. (B.O.G.)

28428 (LAMS-2573) MECHANICAL QUADRATURE AND THE TRANSPORT EQUATION. Bengt G. Carlson and Clarence E. Lee (Los Alamos Scientific Lab., N. Mex.). June 1961. Contract W-7405-ENG-36. 13p.

Methods of quadrature over the unit sphere with emphasis on rotational symmetry are discussed briefly in relation to the problem of integrating the Neutron Transport Equation over the angular variable. Tables of quadrature coefficients are given for a particular method having the desired symmetry properties, and for two other methods. (auth)

28429 (NAA-SR-6104) THE FOG ONE-DIMENSIONAL NEUTRON DIFFUSION EQUATION CODES. H. P. Flatt (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 15, 1961. Contract AT (11-1)-GEN-8. 47p.

The FOG one-dimensional neutron diffusion equation codes provide a convenient tool for many reactor calculations. Provisions are made in the codes for calculating the flux and the adjoint flux, and for performing various criticality searches. Provision is also made for a buckling iteration calculation and an automatic calculation of extrap-

olation factors. The code is limited to a maximum of 4 energy groups, 40 regions, and 239 space points. (auth)

28430 (NAA-SR-Memo-6545) FAST NEUTRON CROSS SECTION AND ANGULAR DISTRIBUTION DATA APPLICABLE TO MONTE CARLO CALCULATION. H. Alter (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 26, 1961. 133p.

Necessary cross section data for treating reactor and penetration problems by Monte Carlo methods are presented. Neutron total elastic and inelastic cross sections for a range in energy of 0.01 to 14 Mev are listed pointwise in energy. A minimum of 50 points was used in the description of integral data. In addition, methods of treating anisotropic elastic and inelastic scattering are discussed and data relating to the scattering anisotropy are given. A method is presented by which the cosine of the scattering angle may be drawn directly from a probability distribution. (auth)

28431 (NDA-2106-10) PENETRATION OF NEUTRONS FROM A POINT FISSION SOURCE IN AIR; MOMENTS METHOD CALCULATION. D. Spielberg (United Nuclear Corp., White Plains, N. Y.). Apr. 28, 1961. Contract DA-30-069-505-ORD-2460. 42p. (WAL-TR-551.1/2)

Calculations were performed, using the moments method, to determine the spatial and energy distribution of neutrons from a point fission source in a uniform homogeneous air medium. The calculated fluxes were used to obtain the spatial variations of the physical and biologocal neutron doses, and the spatial distribution of radiative captures in nitrogen. In addition, the gamma dose due to radiative-capture gamma rays was evaluated in air at various distances from the neutron source. The results include the coefficients in analytic approximations for the spatial neutron fluxes at 108 energies, at equal intervals of 0.2 in ln E, from 18.02 Mev to 0.00916 ev. (auth)

28432 (NRL-5632) A COMPARISON OF THE NEUTRON BEAMS FROM A RADIAL BEAM PORT AND FROM THE TANGENTIAL PORT OF THE NRL REACTOR AS SOURCES FOR NEUTRON-CAPTURE GAMMA RAYS. Final Report. R. H. Vogt (Naval Research Lab., Washington, D. C.). Apr. 17, 1961. 7p.

In the electron-volt region of neutron energies the neutron beam from a radial port (R-3) provides low-energy capture gamma rays from heavy nuclides which have intensities from 2 to 6 times those given by the beam from the parallel tangential port striking the same target materials. The signal-to-background ratios are comparable in the two cases for the geometries used. The intensities of high-energy gamma rays in the direct beam from R-3 are from 5 to 10 times that of the same-energy gamma rays in the tangential beam. (auth)

28433 CALCULATION OF THE PASSAGE OF FAST NEUTRONS THROUGH CYLINDRICAL CHANNELS IN A BIOLOGICAL SHIELD. B. R. Bergel'son. Atomnaya Energ., 10: 388-9(Apr. 1961). (In Russian)

The passage of neutrons across a void and the resulting attenuation are analyzed, and the equation for fast neutron passage through a cylindrical void is reduced to $I = (I_0 \pi \delta^2 / 2\pi H^2)$ (where I is the neutron flux from a cylindrical channel with δ radius and H length, and I_0 is the isotropic plane source intensity). Hence, the passage of the neutrons through a cylindrical void in shielding is determined by geometric beam collimation by the channel walls. A rectifying multiplier β, equal to 10, is required in the case where the source dimension is larger than the channel diameter and fast neutrons may enter the channel by diffusing through the source-to-channel shielding instead of directly from the source. The age approximation is used for determining the neutron distribution in the media surrounding the channel at distances not exceeding $\sim 2\lambda$. A solution is given for an infinite plane layer of H-thick shielding attenuated by a single δ-radius, H-long cylindrical channel in a fast E_0 neutron flux of I_0 n/cm^2/sec. (R.V.J.)

28434 TRANSMISSION OF WATER, ALONE OR WITH A HEAVY COMPONENT, FOR NEUTRONS OF ENERGIES 0.5 AND 1.0 Mev. V. I. Kukhtevich and B. I. Sinitsyn. Atomnaya Energ., 10: 511-13(May 1961). (In Russian)

The spatial distributions of thermal and supercadmium neutrons formed by attenuation of 0.5 and 1.0 Mev neutrons in water were measured, and carbon, iron, and lead cross sections for the same energy neutrons were determined. The results were correlated with calculations. The measurements were carried out in semi-infinite geometry. (R.V.J.)

28435 THE NEUTRON DISTRIBUTION IN MEDIA HAVING A CYLINDRICAL INTERFACE AND AN OFF-AXIS SOURCE. A. E. Glauberman, V. B. Kobylyanskii, and I. I. Tal'yanskii. Atomnaya Energ., 10: 513-15(May 1961). (In Russian)

The problem of neutron distribution from a fast source at the bore-hole axis was resolved by A. E. Glauberman et al. (Atomnaya Energiya 3, No. 23, 1957). An attempt is made to determine the effects of off-axis source position on the influence of external media on neutron flux inside the bore-hole. (R.V.J.)

28436 THE SPECTRUM AND TEMPERATURE OF THE NEUTRON GAS IN A GRAPHITE–WATER REACTOR. E. Ya. Doil'nitsyn and A. G. Novikov. Atomnaya Energ., 10: 517-19(May 1961). (In Russian)

Spectrum characteristics of thermal neutrons stabilized in various moderators are evaluated. A mechanical neutron selector with a 256 channel time analyzer was used for measuring graphite–water reactor thermal neutron spectra at temperatures from 300 to 800°K. The neutron spectra at a reactor power of 0.05% are plotted. Neutron gas temperatures measured using the spectral data and boron filters are plotted as function of reactor power (0.05, 15, 20, 50, and 70%) and graphite temperature. (R.V.J.)

28437 THE DIFFUSION LENGTH OF THERMAL NEUTRONS IN POISONED WATER. M. Reier (Westinghouse Electric Corp., Pittsburgh). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 14: 186-8(July 1961).

The diffusion length of thermal neutrons has been measured in water poisoned with boron in amounts such that $\Sigma_{aB} = 0.5$, 1.0, and 1.5 Σ_{aH}. The data indicate that $1/L^2$ is a linear function of Σ_a for pure water and the two weaker poisons. For the maximum poison used, however, $1/L^2$ departs from the straight line, revealing the presence of a spectral hardening effect. The value of the diffusion constant, $D_0 = Dv$, calculated from the data, equals 37618 ± 205 cm^2/sec. Assuming that $\sigma_{aB} = 755 \pm 2b$, σ_{aH} is calculated to be 0.328 ± 0.006b. In addition, the case of a non 1/v absorber, cadmium is treated. (auth)

28438 THE ABSORPTION OF NEUTRONS BY THE $O^{16}(n,\alpha)C^{13}$ REACTION IN AN EXTENDED WATER MODERATOR. M. H. McTaggart (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 14: 212-13(July 1961).

28439 PARTICLE SELF-SHIELDING IN PLATES LOADED WITH SPHERICAL POISON PARTICLES. W. B. Doub (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 10: 299-307(Aug. 1961).

An approximate heuristic expression is derived for the particle self-shielding factor for a set of purely absorbing spheres, of radius r and volume fraction V, that is well mixed with another set of non-absorbing spheres. The resulting expression is experimentally verified using transmission data at several incident neutron energies for a plate-type sample containing a mixture of aluminum and boron-carbide spheres with nominal diameters 85 ± 15μ. The boron-carbide spheres occupy about 37% of the sample volume. The transmission is measured at energies ranging from 0.03 to 1.2 ev using a crystal neutron spectrometer. Since, however, the sample contains boron-carbide spheres with a distribution of diameters, the experimental self-shielding factors are "average" values. It is shown, using an approximate model, that a plausible theoretical self-shielding factor is a volume weighted average of the self-shielding factors for the spheres of each diameter. (auth)

Nuclear Properties and Reactions

28440 (AE-59) STUDIES OF THE EFFECTIVE TOTAL AND RESONANCE ABSORPTION CROSS SECTIONS FOR ZIRCALOY 2 AND ZIRCONIUM. E. Hellstrand, G. Lindahl, and G. Lundgren (Aktiebolaget Atomenergi, Stockholm). 1961. 26p.

The total absorption cross section for Zircaloy-2 plates of thickness varying from 0.2 to 6.4 mm was determined in the neutron spectrum of the R1 reactor. The effective resonance integrals were obtained by subtracting the thermal cross section from the measured cross sections and dividing by the factor α. Effective resonance integrals were also obtained for zirconium after corrections for hafnium, tin, etc. An extrapolated value of 0.85 ± 0.15 b was obtained for the infinitely dilute integral ($1/\nu$ part excluded). The ratio of the resonance integral for plate thicknesses 0.2 and 6.4 mm was measured to be 1.65 ± 0.25. (D.L.C.)

28441 (AFOSR-1163) LINEAR RESPONSE FUNCTION OF A MANY FERMION SYSTEM. Technical Note No. 10. Arnold J. Glick (Weizmann Inst. of Science, Rehovoth, Israel). May 1, 1961. Contract AF61(052)-337. 56p.

The properties of a many-body system were studied by means of a "linear response function" which depends on frequency and wave number. It is shown that the expectation value of two body operators, the rate of transitions induced by one body operators or weak external fields acting on the system, and information about the energy spectrum can be found from this function. As a result, the formalism suggests many relationships between apparently dissimilar quantities, and suggests indirect ways of experimentally measuring internal properties of a system. In the present formalism, all of the difficulties inherent in many body calculations are related to the determination of the response function. However, there exist some rules and a priori conditions on this function which can be used to estimate the validity of approximate calculations and to indicate what must be done to improve the results. The response function was calculated for a Fermi gas by using a combined diagrammatic perturbation theory and Green's function technique. Expressing the response function in terms of the irreducible particle-hole propagator, it is shown that any fermion system with repulsive interactions between particles can be expected to respond strongly at certain frequencies at least for disturbances of very small wave number. This enhanced response can be associated with the excitation of a plasmon or second sound. Some new results for the electron gas are also mentioned. (auth)

28442 (AFOSR-1164) THE ANALYTIC STRUCTURE OF MANY BODY PERTURBATION THEORY. Technical Note No. 11. Amnon Katz (Weizmann Inst. of Science, Rehovoth, Israel). May 10, 1961. Contract AF61(052)-337. 33p.

The Goldstone linked cluster expansion was used to determine the energy as an analytic function of the coupling constant. This function is much valued and describes the various energy levels of the system. The energy of each level can be obtained from the Goldstone expansion by continuing it analytically along a properly chosen path in the complex plane. The Brueckner ladder approximation is shown to be an approximation to an analytic continuation along a path which always leads to the normal state, the state in which no binding occurs. (auth)

28443 (AFOSR-TN-832) ROTATIONAL SPECTRA IN THE NUCLEAR SHELL MODEL. Technical Note No. 40. Raymond S. Willey (Stanford Univ., Calif. Inst. of Theoretical Physics). May 1961. Contract AF49(638)-388. 35p.

The problem is discussed of obtaining rotational spectra within the framework of a shell model calculation. There is some discussion of this problem in the literature. In particular, it was stated or hinted that a degenerate oscillator Hamiltonian plus residual quadrupole-quadrupole interaction of the form $V = -\sum_{i<k} r_i^2 r_k^2 P_2(\cos\theta_{ik})$ or of the form $V = -\sum_{i,k} r_i^2 r_k^2 P_2(\cos\theta_{ik})$, the second form differs from the first in that it includes "self-energy" terms, leads to rotational spectra if only the matrix elements of V between states in the same oscillator shell are kept. Neither of the forms are quite correct. The general arguments are reviewed for the existence of rotational spectra and obtain the correct residual potential. The results are checked by directly diagonalizing the energy matrix for the simple case of two particles in the |2s 1d| shell. (auth)

28444 (AFOSR-TN-1218) QUASI-ELASTIC PEAK IN HIGH ENERGY NUCLEON–NUCLEON SCATTERING. Technical Note No. 43. S. D. Drell and K. Hiida (Stanford Univ., Calif. Inst. of Theoretical Physics). July 1961. Contract AF49(638)-388. 26p.

In the scattering of very high-energy protons from the nucleons within target nuclei, it is found that the scattered protons have a distribution of energies. These experiments, performed at CERN, show a sharp peak in the energy distribution which corresponds to elastic scattering of the incident protons, and also a broader peak at somewhat lower energy which corresponds to nearly elastic scattering of the incident protons. An explanation of this latter quasi-elastic peak is offered in terms of the diffraction scattering of one of the pions in the cloud of the target nucleon. This diffraction scattering of the pion by the incident nucleon results in a moderate energy loss of the nucleon, so that it emerges in the quasi-elastic peak. (auth)

28445 (ARL-29) THEORETICAL INTERPRETATION OF ENERGY LEVELS IN LIGHT NUCLEI. I. Talmi and I. Unna (Weizmann Inst. of Science, Rehovoth, Israel). May 1961. Contract AF61(052)-56. 65p.

A study is made of the shell model description of nuclear states, and of methods of calculating the energies of these states and the transition rates between them. Isotopes of C, N, O, F, Ne, S, Cl, Ar, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, and Ni are included in the study. Values of the effective interactions in nuclei with $Z \leq 10$ are given. (auth)

28446 (CRDC-1007) TABLES OF GAMMA RAYS FROM THE DECAY OF RADIONUCLIDES. R. C. Hawkings, W. J.

Edwards, and E. M. McLeod (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1961. 392p. (AECL-1225)
Issued in two books

The energies and abundances of gamma rays from the decay of those radionuclides having a half life ≥1 sec are listed. The radionuclide decay modes, half lives, and production modes are also listed. (T.F.H.)

28447 (GA-2151) MARITIME GAS-COOLED REACTOR PROGRAM. SUGGESTED VALUES FOR THE PARTIAL CROSS SECTIONS OF U^{235} FOR USE IN THE NEUTRONIC ANALYSIS OF THERMAL AND INTERMEDIATE REACTORS. A. J. Goodjohn and N. F. Wikner (General Atomic Div., General Dynamics Corp., San Diego, Calif.). July 17, 1961. Contract AT(04-3)-187. 46p.

A consistent set of U^{235} partial cross sections for use in the analysis of thermal or intermediate reactor systems is provided. An attempt is made to compile the data in a useful form for such analyses, and several integral checks are made between the cross section data and experimentally determined resonance integrals and capture-to-fission ratios. (auth)

28448 (GA-2527) A PROGRAM OF RESEARCH AND CALCULATIONS OF RESONANCE ABSORPTION. Final Report. L. W. Nordheim (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Aug. 28, 1961. Contract AT(04-3)-167. 45p.

A direct numerical integration of the integral equation for the average collision density in the absorber was previously suggested in a discussion of resonance absorption. The implementation of this program is considered. The method of calculation, comparison with experimental data, and the computer code developed are described. The method of integration, computation of cross sections, selection of mesh size, integration interval, outside correction, the Dancoff correction, and unresolved resonances are discussed. Resonance integrals for U^{238} and Th^{232} were calculated and compared with experiment. (M.C.G.)

28449 (JINR-D-740) ON PHOTON–NUCLEON SCATTERING. L. I. Lapidus and Kuang-chao Chou (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 28p.

An analysis was made of the elastic gamma scattering by protons at energies up to 300 Mev by using dispersion relations. Six dispersion relations were used to estimate the real parts of the amplitudes at $Q^2 = 0$. The meson(π) photoproduction was taken into account in a wider energy region than previously. It was proved that the subtraction is necessary in the dispersion relations for at least one amplitude. Five subtraction constants were determined by the low energy limit and expressed in terms of the charge and the nucleon magnetic moment. The differential cross sections and the recoil nucleon polarization were estimated. Gamma-nucleon scattering at high energies is discussed. (auth)

28450 (NP-10428) MASSAVERDELINGEN BIJ SPLIJTING ONDERZOEKINGEN MET EEN FYSISCHE METHODE. (Mass Distribution of the Fragments Resulting from Fission, Investigations by a Physical Method). (thesis). Louis Willem Roeland (Amsterdam. Universiteit). Dec. 17, 1958. 99p.

Bohr's unified model of the nucleus was tested by an investigation of the mass distribution of fragments resulting from fissions induced by neutrons at one particular resonance. After a general introduction to the experimental set-up, A. Bohr's theory is outlined. The construction and properties with respect to fission fragment pulses of gridded ionization chambers are then discussed. The electrical equipment, the neutron filter technique, and some details on the actual performance of the equipment are reviewed. Measurements on U^{235} and U^{233} are then given and discussed. The conclusion is that the dependence of the mass distribution on the spin of the fissioning nucleus, as predicted by A. Bohr, may be proved by an experiment which compares fission by epithermal and thermal neutrons. (J.S.R.)

28451 (NP-10439) GAMMA RAYS EMITTED BY THE 16.1 DAY ISOMER OF RHODIUM-99 AND THEIR COINCIDENCES (thesis). Bernard C. Feigley (Ohio State Univ., Columbus). 1959. 61p.

The 16.1-day isomer of Rh^{99} was studied in an attempt to establish the gamma-gamma coincidence associated with its decay. This long-lived isomeric state was studied by means of a scintillation spectrometer. The findings were correlated with the work done by Townley in an attempt to determine the proper decay scheme for the two isomeric states of the isotope. Instrumentation, preparation of the rhodium samples, and gamma interactions and detection are discussed. Tables and graphs are included. (M.C.G.)

28452 (NP-10545) ON THE PHYSICAL INTERPRETATION OF COMPLEX POLES OF THE S-MATRIX-II. H. M. Nussunzveig (Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas). 1961. 34p. (Notas de Física, Vol. VII, No. 6, p.95-127).

The initial-value problem for a Schrödinger particle interacting with a partially transparent sphere (delta-function potential) is solved by an extension of the method described in Part I. The general solution is expanded in terms of the propagators of transient modes. The relation between this expansion and the stationary-state expansion for an impenetrable sphere is discussed. Special cases considered include the decay of a wave packet initially confined within the sphere, and the scattering of a wave packet by the sphere in the case of a sharp resonance. In the decay problem, the domain of validity of the exponential law and the deviations from this law are investigated. In the resonance scattering problem, the behavior of the solution in the internal and external regions as a function of the width of the excitation is discussed. The concept of time delay at resonance is analyzed. (auth)

28453 (NP-10611) A MEASUREMENT OF THE LONGITUDINAL POLARISATION OF NEON-19 POSITRONS (thesis). Technical Report No. 1. Jovan Vojislava Jovanovic (Washington Univ., St. Louis). May 1961. Contract AF49(638)-843. 97p. (AFOSR-TN-1099)

An experiment to measure the energy dependence of helicity of positrons emitted from Ne^{19} is described. The positron helicity was measured indirectly by transferring it to the annihilation-in-flight photons, whose transmission through a magnetized iron cylinder was dependent on their polarization. The positron helicity therefore resulted in a difference of the counting rates for opposed directions of the magnetic field. The measured dependence of this asymmetry with pulse height was compared with a computation which assumes the validity of the two-component neutrino theory of beta decay and neglects the depolarization of positrons. A good fit of theoretical curve to the experimental points was obtained for pulse heights larger than about 1.3 Mev. A strong disagreement was found in the pulse height range between 0.75 and 1.0 Mev, where the experimental asymmetries were much lower than the prediction. Although the influence of the induced pseudoscalar interaction cannot be excluded, it is likely that this discrepancy was produced by the depolarization of positrons

due to multiple Coulomb scattering. The measurement of the asymmetry of bremsstrahlung produced in copper by electrons from a $Sr^{90}-Y^{90}$ source was used in order to measure the effective number of aligned electrons in the magnetized iron cylinder. It was assumed, in agreement with measurements performed previously, that the polarization of Y^{90} electrons is equal to $-(v/c)$. By comparison with the bremsstrahlung asymmetries at the higher energy part of the spectrum, the helicity of the Ne^{19} positrons was determined to be $H = (0.97 \pm 0.10)(v/c)$ for positron energies greater than about 1.2 Mev. No conclusion about the positron helicities at lower energies can be obtained until the effect of the depolarization is carefully accounted for. (auth)

28454 (NYO-2965) MEASUREMENT OF THE NUCLEAR SPIN OF C^{11} BY THE ATOMIC BEAM METHOD (thesis). Joseph L. Snider (Princeton Univ., N. J. Palmer Physical Lab.). July 1961. Contract AT(30-1)-937. 166p.

The nuclear spin of 20.4-minute C^{11} was measured to be $^3/_2$ by the atomic beam magnetic resonance method. This value is the same as the known spin of its charge-conjugate nucleus B^{11}, consistent with the charge symmetry of nuclear forces. Zeeman resonances in the metastable $^3P_2$ and $^3P_1$ atomic states were observed at three values of magnetic field up to ≈1.3 mc/sec. The C^{11} activity was produced in the Princeton cyclotron by the $B^{11}(p,n)C^{11}$ reaction on natural boron, and was continually flushed in gaseous molecular form by a flow of neon through a 350-ft pipe from the cyclotron to the apparatus, thus maintaining the beam intensity constant over the length of a run. A microwave discharge dissociated the molecules to produce a beam of C^{11} atoms which were collected on silver-plated copper collectors held at ≈ −70°C and detected by counting their decay positrons. The design of the atomic-beam apparatus, a new type combining the advantages of high sensitivity, flop-in operation and small detector area, is described. An experiment on the magnetic moment of N^{13} is described. Resonances were observed in the $^4S_{3/2}$ ground state at frequencies to ≈29 mc/sec. The measured value of the hyperfine structure constant, a, is: $|a| = 16.5 \pm 0.3$ mc/sec. When this is combined with known data for N^{15}, the result is: $|\mu_1|_{N^{13}} = 0.320 \pm 0.006$ n.m. The sign of the moment was not measured but is almost certainly negative. This result, in conjunction with the known moment of C^{13}, provides a second pair of charge-conjugate nuclei for which both ground state moments are known, the only other one being He^3-H^3. A brief discussion of the significance of the results for the two mirror pairs is given. (auth)

28455 (TID-13424) LARGE-ANGLE SCATTERING OF 18.7-MEV ALPHA PARTICLES BY C^{12}. S. S. M. Wong and E. Bleuler (Purdue Univ., Lafayette, Ind.). [1960]. [Contract AT(11-1)-123]. 18p.

The differential scattering cross section (σ) for the elastic scattering of 18.7 Mev α particles from C^{12} is measured from 165 to 179°(c.m.). A rapid rise is observed in σ in this angular range. It is found that σ does not pass through a peak near 180°, but rises steadily to a value of 1.2 ± 0.1 barn/sterad at 180°. (T.F.H.)

28456 (UCRL-6470) PROTON CAPTURE GAMMA RAYS FROM Si^{28} IN THE REGION OF THE PHOTONUCLEAR GIANT RESONANCE (thesis). Calvin C. Gardner (California. Univ., Livermore. Lawrence Radiation Lab.). May 6, 1961. Contract W-7405-eng-48. 44p.

The Livermore 90-inch variable-energy cyclotron was used to measure the 90° excitation function for the $Al^{27}(p,\gamma)Si^{28}$ reaction. Proton energies between 5 and 13 Mev were used which gave excitation energies in Si^{28} corresponding to the region of the photonuclear giant resonance. Two gamma rays were observed: γ_0, the ground-state gamma ray and γ_1 resulting from deexcitation through the first excited state of Si^{28} at 1.78 Mev. They were detected by a 5-in.-diam by 6-in.-long NaI(Tl) crystal. A Pb collimator was used to improve the resolution of the detector. The results indicated that both γ_0 and γ_1 display the giant resonance behavior; the γ_0 curve reached a peak value of ~8 μbarns/sr at $E_p = 8.75$ Mev, while the γ_1 peak was ~14 μbarns/sr at $E_p = 10$ Mev. Both curves displayed the fine structure previously reported by Gove et al. A detailed balance calculation was made, using the γ_0 data. A comparison with the measurements of Johansson on the total yield of protons from the $Si^{28}(\gamma,p)Al^{27}$ reaction indicated that about $^1/_3$ of the total photoproton production in Si^{28} results in maximum energy, or ground-state protons. It was concluded that this large proportion strongly suggests a direct interaction reaction mechanism. (auth)

28457 (UCRL-9724) EFFECTS OF ANGULAR MOMENTUM ON GAMMA-RAY PRODUCTION IN COMPOUND NUCLEUS REACTIONS (thesis). James Frederick Mollenauer (California. Univ., Berkeley. Lawrence Radiation Lab.). June 1960. Contract W-7405-eng-48. 117p.

The yields and spectra of gamma rays produced in compound nucleus reaction were measured by a coincidence technique. Pulses from the gamma detector were required to be in coincidence with pulses indicating the removal of a charged particle from the beam. The effect of the angular momentum of the compound system was studied by using pairs of targets producing the same compound nucleus when bombarded with helium and with carbon ions. For the carbon-ion reactions studied, the total energy appearing in gamma rays was greater than the neutron binding energy. This result disagreed with the assumption of evaporation theory that nucleon emission is preferred when possible. The increased gamma yield was shown to depend on angular momentum at constant excitation energy. The anisotropy of the gamma radiation indicated that the transitions involved in the de-excitation were primarily quadrupole when the angular momentum brought in was approximately 10 to 15 units. A greater fraction of dipole transitions was apparent for larger angular momenta. Both the anisotropy and the average photon energy were inconsistent with predictions based on single-proton transitions. Collective modes were probably involved in the radiative processes; the average and total gamma energies were more consistent with vibrational than with rotational transitions. (auth)

28458 (UCRL-9730) THE EFFECT OF PAIR INTERACTION ON NUCLEAR MATTER (thesis). Yih Pwu (California. Univ., Berkeley. Lawrence Radiation Lab.). June 5, 1961. Contract W-7405-eng-48. 106p.

Sawada's Hamiltonian was used once again to study the eigenstates of nuclear matter by adding a momentum dependence to the effective potential. It is shown that the condition for zero sound propagation in nuclear matter is very sensitive to the asymmetry as well as to the average strength of the effective potential between the colliding nucleons at the Fermi surface. And a calculation of the energy of this model Hamiltonian proved that the correction from pair interactions to the first-order Brueckner's expression of nuclear ground-state energy is small. (auth)

28459 (UCRL-9749) ELASTIC AND CHARGE-EXCHANGE SCATTERING OF K^- MESONS IN HYDROGEN (thesis). Ronald Rickard Ross (California. Univ., Berkeley. Lawrence Radiation Lab.). June 21, 1961. Contract W-7405-eng-48. 76p.

Cross sections for elastic and charge-exchange scatter-

ing of K^- mesons incident on hydrogen are reported at 25-Mev/c intervals from 100 to 275 Mev/c. These cross sections were combined with the cross sections for charged- and neutral-hyperon production and the at-rest hyperon-production ratios to determine the s-wave zero-effective-range parameters that best fit the low-energy K^--p interactions. Two sets of parameters were found that give acceptable fits to all the data. The χ^2 test gave probability of 48% for Solution 1, and 8% for Solution 2. Analysis of the elastic-scattering angular distribution, independent of the zero-effective-range analysis, showed that the nuclear part of the amplitude has a large imaginary part and real part consistent with zero. Values of modulus and phase of this amplitude for the two intervals in P_K lab from 100 Mev/c to 175 Mev/c and from 175 to 250 Mev/c are given. (auth)

28460 (USNRDL-TR-500) THE ACTIVATION OF SODIUM, MANGANESE, AND ALUMINUM IN NEVADA TEST SITE SOIL. F. M. Tomnovec (Naval Radiological Defense Lab., San Francisco). Feb. 21, 1961. 33p.

In a laboratory experiment employing 12-Mev protons on beryllium as a neutron source, the neutron activation and resultant distribution of radioactive Na^{24}, Mn^{56}, and Al^{28} in Nevada Test Site soil was found to be similar to actual data taken at a nuclear weapon field test. This established the laboratory experiment as a valid predictor for the neutron activation of soil elements from atomic weapon neutron fields. Results indicated that large amounts (10 to 20%) of the activation of Na^{24}, Mn^{56}, and Al^{28} are produced by neutrons above the cadmium cutoff threshold. From the data, the resonance integrals of sodium, manganese, and aluminum were calculated. (auth)

28461 (CEA-tr-R-1182) SECTION EFFICACE TOTALE DU TRITIUM POUR LES NEUTRONS DE 2, 5 ET 14 MeV. (Effective Total Cross Section of Tritium for Neutrons of 2.5 and 14 Mev). L. N. Katzaurov, R. M. Mussaelian, and V. I. Popov. Translated into French by B. Vinogradoff from Atomnaya Energ., Suppl. No. 5, 71-4 (1957). 6p.

The total cross section of tritium was measured for neutrons at 2.5 and 14 Mev by comparing the transparence of ordinary and tritiated water (9.2% tritium in the total hydrogen). The values obtained are $\sigma_{2.5\ Mev} = 2.5 \pm 0.5$ b and $\sigma_{14\ Mev} = 0.63 \pm 17$ b. The value for the cross section at 14 Mev is in good agreement with the theoretical values, but the results for 2.5-Mev neutrons do not. The results are compared with those obtained earlier. (J.S.R.)

28462 ANALYSIS OF THE ELASTIC AND INELASTIC SCATTERING OF 19-MEV DEUTERONS ON C^{12}. J. Catalá, E. Villar, A. García, F. Senent, and J. Aguilar (Faculatad de Ciencias, Valencia). Anales real soc. espãn. fís. y quím. (Madrid), Ser. A, 56: 293-300(Nov.-Dec., 1960). (In Spanish)

The angular distributions for the elastic and inelastic scattering of 19.17-Mev deuterons by C^{12} nuclei were measured using the photographic technique. The observed distributions were checked with the general predictions of the nuclear optical model and of the direct interaction theories of Huby-Newns and Austern-Butler-McManus. (auth)

28463 SCATTERING OF 29-MEV He^3 PARTICLES BY CCl_4. J. Catalá, A. Lleó, A. García, M. C. Altés, and J. Aguilar (Facultad de Ciencias, Valencia). Anales real soc. espãn. fís. y quím. (Madrid), Ser. A, 56: 301-5(Nov.-Dec., 1960). (In Spanish)

The differential cross section for the elastic scattering of 29 Mev He^3 particles by chlorine was measured using the photographic technique. The elastic scattering angular distribution was compared with Rutherford scattering and an approximate value of 6.05 ± 0.37 fermis is obtained for the radius of interaction using the diffraction formula for a strongly absorbing disc. (auth)

28464 BETA-GAMMA ANGULAR CORRELATION AT RESONANCE AND TYPES OF BETA INTERACTION. Maurice Spighel (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). Ann. phys. (13), 6: 535-94 (May-June 1961). (In French)

With a linear approximation the Dirac equation permits the classification of β interactions into five types of interaction: S, V, T, A, and P. The respective densities of these five types of interaction were studied. One means of determining these densities is the study of the beta-neutrino angular correlation. This correlation can be studied indirectly without the necessity of detecting the recoil nucleus by following the β-γ angular correlation at resonance following a β decay. A theoretical study was made principally in the case of forbidden β transitions of the first order. This transition was studied for As^{76}. (J.S.R.)

28465 STUDY OF THE EMISSION OF NEGATIVE ELECTRONS ACCOMPANYING β AND α ACTIVITIES, BY THE COINCIDENCE TECHNIQUE. Maurice Duquesne (Collège de France, Paris). Ann. phys. (13), 6: 643-702 (May-June 1961). (In French)

A study is made to extend as far as possible the utilization limits of the coincidence method ($\beta - e^-$) by working out a geometry and methods adapted to eliminate parasite coincidences. This coincidence technique is then applied to the study of some nuclear physics problems. An e^- spectrum in coincidence with the β radiation was detected for the pure β emitters S^{35}, P^{32}, Pm^{147}, and RaE. The maximum energy of the spectra is in sharp disagreement with the energies fixed by the theory of self-ionization; nevertheless, the total intensity of the phenomena is of the order of magnitude fixed by this theory and corresponds with the measurements of the intensity of the characteristic x radiation. A similar study was made for the α emitter Po^{210}, and it was shown that the energy and the intensity of the e^- emitted correspond to the order of magnitude fixed by the theory of self-ionization. (J.S.R.)

28466 ON THE THEORY OF SPIN PARAMAGNETISM. Louis Goldstein (Los Alamos Scientific Lab., N. Mex.). Ann. Phys. (N. Y.), 15: 141-56(Aug. 1961).

The expression is derived for the partial entropy of spin orientation in the spin system associated with a collection of bound atoms subject to the Pauli principle, whose mutual interactions depend uniquely on their space coordinates and whose Hamilton function is independent of the spin coordinates of the atoms. These restrictions on the Hamilton function of the system are the same which yield the quantum mechanical foundation of the molecular field description of spin ferromagnetism and paramagnetism in metals. The absence of the spin coordinates from the Hamiltonian insures the behavior of the spin system as if it were free. The enumeration of the various spin configurations or spin states, which determine the orientational spin disorder, proceeds as in a system of free spins, subject though to an internal field tending to resist the thermal spin disorder in this non-ideal paramagnetic system through a reduction of its total spin angular momentum. The results obtained confirm those given previously on the basis of the magnetization process of a class of non-ideal paramagnetic systems subject to the postulated existence of a molecular field. (auth)

28467 REACTIONS IN THE A = 4 SYSTEM. PART III. T(p,n). James E. Young and Paul R. Stein (Los Alamos

Scientific Lab., N. Mex.). Ann. Phys. (N. Y.), 15: 157-92 (Aug. 1961).

An analysis is presented of the charge exchange reaction T(p, n). The model used is basically that proposed by Selove, a direct interaction model. A cluster model (deuteron plus neutron) representation of the three-body ground state is assumed. Further, the relevant interactions, knock-on and core pickup, between proton and target are characterized through the Yamaguchi separable t-matrix, a nonlocal operator. The impulse approximation (t in the medium equals t for free scattering) is introduced. Certain other approximations having to do with the nuclear form factors and the smallness of momenta components of the bound neutron are also employed. Calculations are presented in which a comparison is made with the differential cross sections at 1.75, 3.0, and 5.5 Mev. The observed dependence of back to forward scattering upon energy is represented. (auth)

28468 ON THE DEUTERON AS A FREE NUCLEON TARGET AT 145 Mev. A. F. Kuckes, Richard Wilson, and Paul F. Cooper, Jr. (Harvard Univ., Cambridge, Mass.). Ann. Phys. (N. Y.), 15: 193-222(Aug. 1961).

The quasielastic p−p scattering in the deuteron was studied at 145 Mev. Cross sections and asymmetries in a polarized beam were measured. No deviation was found from the simple impulse approximation predictions for the asymmetries. For the cross section, deviations of up to a factor of two were found for cases where the struck particle had a large momentum before collision. It is shown that the extrapolation procedure suggested by Chew and Low can be qualitatively used to relate the results. The use of the extrapolation procedure in other similar cases is discussed. (auth)

28469 PERTURBATION METHOD FOR LOW STATES OF A MANY-PARTICLE BOSON SYSTEM. H. W. Jackson and E. Feenberg (Washington Univ., St. Louis). Ann. Phys. (N. Y.), 15: 266-95(Aug. 1961).

A theoretical description of the ground state and low excited states of liquid He^4 is developed in terms of a set of correlated basis functions. Starting from a simple correlated trial function ψ_0 suitable for an approximate description of the ground state under the assumption of a strong replusive force when two particles approach closely, the function ψ_0 and a set of model functions φ_n are used to construct a set, $\psi_n = \psi_0\varphi_n$, of linearly independent correlated basis functions. Matrix elements of the identity and Hamiltonian operator are evaluated by systematic application of a generalized Kirkwood type superposition approximation. A normalized, orthogonal basis $|e_n\rangle$ is constructed from linear combinations of the functions ψ_m; the associated matrix elements $\langle e_n|H|e_m\rangle$ vanish everywhere except on the three diagonals m = n, n ± 1. This result is a consequence of an appropriate choice of the model functions and use of the superposition approximation in evaluating the matrix elements. At this point is it proper to speak of a free phonon description. A final approximate diagonalization, neglecting phonon-phonon interaction, yields explicit formulas for the ground state energy and the momentum dependence of the phonon energy. The analogy with Bogoliubov's treatment of the boson system, using uncorrelated basis functions is very close as is also the relation to Feynman's theory of the excitation energies. A parallel analysis is successful with ψ_0 taken to be the correct ground-state eigenfunction. In this case the matrix elements of the phonon-phonon interaction can be expressed completely in terms of the elementary liquid structure function as given by the analysis of x-ray diffraction at low temperatures. The way is open to an accurate evaluation of the phonon energy as a function of momentum (the Landau curve) and a corresponding accurate evaluation of the thermodynamic properties of the liquid at low temperatures. (auth)

28470 EXPERIMENTAL INVESTIGATION OF THREE PROTON GROUPS AND ONE ALPHA PARTICLE GROUP OBTAINED FROM DEUTERON BOMBARDMENT OF N^{14} AT LOW ENERGIES. Bo Sjögren and Zdzislaw Sawa. Arkiv Fysik, 19: 417-28(1961). (In English)

Excitation functions and angular distributions of the three most energetic proton groups from $N^{14}(d,p)N^{15}$ and the ground state group from $N^{14}(d,a)C^{12}$ were measured for deuterons in the region 500−800 kev. In all the cases studied some resonance structure is obtained at deuteron energies around 700 kev. The anomaly is most pronounced in the angular distributions. In the total cross section for the ground state protons the available data also seem to give an indication of a small bump at 700-800 kev (corresponding to an excitation of about 21.4 Mev in O^{16}). (auth)

28471 NUCLEAR SPECTROSCOPY ON Tl^{197} SOURCES. B. Jung and J. Svedberg (Univ. of Uppsala). Arkiv Fysik, 19: 429-40(1961). (In English)

The conversion electron spectrum of mass-separated Tl^{197} was studied at 5 to 2000 kev in a double focusing β spectrometer, adjusted to a momentum resolution of about 0.5%. Energy sum and intensity relations between the γ transitions indicate the following level sequence in $_{80}Hg^{197}$: ground state ($\frac{1}{2}-$), 133.95 ($\frac{5}{2}-$), 152.15 ($\frac{3}{2}-$), 308.5 ($\frac{3}{2}-$), 578.1 ($\frac{1}{2}-$), and 585.6 kev ($\frac{3}{2}-$). The level scheme was partially checked by measurements of e^--γ coincidences. The half life of Tl^{197} was found to be 2.84 ± 0.04 h. Conversion electron lines in the decay of the daughter nucleus Hg^{197}(65 h) were studied to some extent. (auth)

28472 THE INTERNAL CONVERSION ELECTRON SPECTRUM OF Pb^{196}. J. Svedberg and B. Jung (Univ. of Uppsala). Arkiv Fysik, 19: 441-6(1961). (In English)

The electron spectrum of mass separated sources of Pb^{196} was studied with a momentum resolution of about 0.5% in a double focusing β spectrometer. The following tentative level scheme of Tl^{196} is proposed: ground state (2−), 191.8 (0−), 240.3 (2−), 253.2 (1− or 2−), 366.6, 494, and 503 kev. (auth)

28473 LEVELS IN Hg^{195}, POPULATED IN THE DECAYS OF Tl^{195}(1.2h) AND Hg^{195m}(40 h). B. Jung and J. Svedberg (Univ. of Uppsala). Arkiv Fysik, 19: 447-59(1961). (In English)

Measurements of the internal conversion electron spectrum of Tl^{195} yielded conversion lines of the following new γ transitions in Hg^{195}: 225.8 (M1), 242.1 (M1), 247.3 (M1 + E2?), 279.2 (M1), 562, and 883 kev. The half life of Tl^{195} was measured to be 1.16 ± 0.05 h. A study of the low-energy part of the conversion electron spectrum of Hg^{195m} revealed conversion electron lines of a new 16.20 kev M1 transition, converted in mercury. In this spectrum indications were found also of a new 53.3 kev transition of E2 character. All sources were electromagnetically mass separated. From the combined information, obtained in the measurements on the two decays, the following level sequence in Hg^{195} is proposed: ground state ($\frac{1}{2}-$), 37.16 kev ($\frac{3}{2}-$), 53.4 kev ($\frac{5}{2}-$), 176.4 kev ($\frac{13}{2}+$), and 279.2 kev ($\frac{3}{2}-$). The systematics of levels in odd mass mercury isotopes is discussed briefly. (auth)

28474 NUCLEAR SPINS OF NEUTRON-DEFICIENT POLONIUM ISOTOPES. S. Axensten and C. M. Olsmats (Univ. of Uppsala). Arkiv Fysik, 19: 461-8(1961). (In English)

The atomic-beam magnetic resonance method was used to measure the spins of neutron-deficient polonium isotopes with the following results for mass number, half-life, and spin, respectively: 201, 18 m, and 3/2; 202, 43 m, and 0; 203, 42 m, and 5/2; 204, 3.6 h, and 0; 205, 1.8 h, and 5/2; 206, 8.8 d, and 0; 207, 5.7 h, and 5/2; and the atomic g-factor of polonium $g_j = 1.39609 \pm 0.00004$. There is some uncertainty as to the spin 0 assignments. For very small hfs, the resonance frequencies for spins other than zero are nearly identical to the transition frequency for spin 0. For that reason an upper limit for the magnetic dipole interaction constant was calculated under the assumption that the spin is one. (auth)

28475 HYPERFINE STRUCTURE INVESTIGATION OF Po^{205} AND Po^{207}. C. M. Olsmats, S. Axensten, and G. Liljegren (Univ. of Uppsala). Arkiv Fysik, 19: 469-81(1961). (In English)

The atomic-beam magnetic resonance method was used to study magnetic and electric hfs interactions in the atomic ground state of Po^{205} and Po^{207}. For Po^{205} the conventional technique was used and the magnetic dipole and electric quadrupole interaction constants were obtained. For Po^{207} a double resonance method was introduced which enabled the observation of an hfs separation which cannot be measured with the ordinary "flop-in" technique. In this way, besides the magnetic dipole and the electric quadrupole interaction constants, also the magnetic octupole interaction constant as well as the signs of these constants were computed. The second order perturbation energy of the non-central interaction Hamiltonian was taken into consideration. From the interaction constants the nuclear moments were calculated and compared with those obtained from the single-particle model. (auth)

28476 MEAN NUMBER OF NEUTRONS PRODUCED IN THE FAST-NEUTRON FISSION OF Np^{237}. V. I. Lebedev and V. I. Kalashnikova. Atomnaya Energ., 10: 371-2(Apr. 1961). (In Russian)

The mean number of neutrons produced $\underline{\nu}$ in Np^{237} fission by fast neutrons was measured in relation to ν for U^{235} fission by slow neutrons. The measurements of $\nu(Np^{137})$ and $\nu(U^{235})$ were made in series and the results were tabulated. The ratio $\nu(Np^{237})/\nu(U^{235}) = 1.197 \pm 0.012$. Assuming $\nu(U^{235})$ is equal to 2.47 ± 0.03, $\nu(Np^{237})$ is 2.96 ± 0.05. (R.V.J.)

28477 TERNARY FISSION IN U^{233}, U^{235}, Pu^{239}, AND Pu^{241}. T. A. Mostovaya. Atomnaya Energ., 10: 372-3 (Apr. 1961). (In Russian)

The probabilities of U^{233}, Pu^{239}, and Pu^{241} ternary fission were correlated with U^{235} probability. Layers of fissionable material 0.1 to 0.2 mg/cm^2 were placed on transparent nylon film. The isotopic compositions were determined by measuring α activity, spontaneous fissions, differential α spectra, and weight. The ratios to U^{235} obtained are: U^{233}, 1.16; Pu^{239}, 1.04; and Pu^{241}, 1.34. (R.V.J.)

28478 TIME COURSE OF THE DECAY OF FISSION PRODUCTS FROM U^{235} AND Pu^{239}. F. K. Levochkin and Yu. Ya. Sokolov. Atomnaya Energ., 10: 403-4(Apr. 1961). (In Russian)

The decay rates of U^{235} and Pu^{239} fission products were analyzed for the period between 2 hours to one year. The plotted results indicate practically identical rates of decay between 2 hours and 200 days. After 200 days a difference appeared that reached 60% toward the end of the year. (R.V.J.)

28479 PRODUCTION AND USE OF POLARIZED RESONANCE NEUTRONS. A. D. Gul'ko, Yu. V. Taran. Atomnaya Energ., 10: 506-8(May 1961). (In Russian)

Resonance level spins of In^{115} and Eu^{151} were determined with a polarized neutron spectrometer. Measurements of the first three In^{115} resonances are tabulated, and the results are in good agreement with published data. Resonance spins measured in Eu^{151} at 0.327 and 0.461 ev are equal to 3 and 2, respectively. The production of resonance neutrons is discussed. (R.V.J.)

28480 RADIATIVE-CAPTURE CROSS-SECTIONS OF Mn^{55}, Cu^{65}, Ba^{138}, AND Th^{232} FOR 0.3 TO 2 Mev NEUTRONS. Yu. Ya. Stavisskii and V. A. Tolstikov. Atomnaya Energ., 10: 508-11(May 1961). (In Russian)

Neutron radiative-capture cross sections for Mn^{55}, Cu^{65}, Ba^{138}, and Th^{232} were measured. The results are plotted and correlated with published data. Contrary to previous data, in which Mn^{55} radiative neutron capture cross sections remain constant, the experimental cross sections drop smoothly with energy along the total neutron energy range. The radiative neutron capture by even-even Ba^{138}, Th^{232} nuclei and odd-odd Cu^{65} nuclei remains constant at a wide neutron energy range with a wide maximum for the Ba^{138} cross section, which indicates the important role of neutrons with $l > 0$. The neutron energy magnitudes at which the cross sections diminish are well correlated with excitation levels. The radiative neutron capture cross sections calculated as functions of the neutron energy according to nuclear reaction statistics and the semi-transparent nuclear model indicate that the $\sigma(n,\gamma)$ relation to neutron energy is determined by the contribution of nuclear waves with $l > 0$ and competition with inelastic scattering. The diminished capture cross section in Th^{232} at $E > 900$ kev is the result of competition with inelastic scattering and fission. (R.V.J.)

28481 ACTIVATION ANALYSIS AS A MEANS OF DETERMINING THE ISOTOPIC COMPOSITION OF LITHIUM. L. P. Bilibin, A. A. Lbov, and I. I. Naumova. Atomnaya Energ., 10: 528-9(May 1961). (In Russian)

A fast and simple activation analysis method for determining the content of Li^6 in a Li^6 and Li^7 mixture is suggested, utilizing the reactions $Li^6(n,\alpha)T$ and $O^{16}(T,n)F^{18}$. (R.V.J.)

28482 NEUTRON YIELDS FROM THE $Li^6(t,n)$ AND $Li^7(t,n)$ REACTIONS. A. K. Val'ter, P. I. Vatset, L. Ya. Kolesnikov, S. G. Tonapetyan, K. K. Chernyavskii, and A. I. Shpetnyi. Atomnaya Energ., 10: 577-86(June 1961). (In Russian)

LiF targets, made by evaporating natural lithium (92.48 wt. % Li^7 and 7.52 wt. % Li^6) and enriched lithium (90.6 wt. % Li^6 and 9.4 wt. % Li^7) onto platinum disks, were struck by tritium particles which had been accelerated up to energies of 2.4 Mev on a horizontal electrostatic generator, and bent at an angle of 60° on a magnetic analyzer. The angular distribution of the neutrons was measured at 0 to 135° on a long, boron, proportional counter at tritium energies of 0.358, 0.559, 1.066, 1.218, 1.370, 1.572, and 2.123 Mev. Four measurements of the neutron count rate were carried out on the front and back side of the LiF targets in order to eliminate the background contribution from scattered neutrons and neutrons obtained from the T(t,n) and C(t,n) reactions. A resonance in neutron yield was observed at $E = 1.875$ Mev in the $Li^6(t,n)$ reaction. This corresponds to an excited level of 18.936 Mev in the compound nucleus Be^9. Two resonances were observed in the neutron yield of the $Li^7(t,n)$ reaction at $E_t = 0.765$ Mev and $E_t = 1.735$ Mev. This indicates the presence of excitation levels of 17.78 and 18.46 Mev respectively in the Be^{10} nucleus. The level widths are 170 kev for Be^9, and 375 and 830 kev respectively for Be^{10}. The differential cross-sections for the formation of neutrons at an angle of 0°

were 37.2 mbarn/stere and 159 mbarn/stere for the first and second resonances of the Li(t,n) reaction. The total cross-section for the formation of neutrons was 324 ± 32.3 mbarns at E_t = 1332 ± 83.3 mbarns for the Li^7(t,n) reaction. (TTT)

28483 ANISOTROPY OF THE FISSION FRAGMENTS FROM Pu^{240} AND Pu^{239}. V. G. Nesterov, G. N. Smirenkin, and I. I. Bondarenko, Atomnaya Energ., 10: 620-2(June 1961). (In Russian)

The energy dependence of the angular anisotropy of fission fragments $\sigma_f(0°,E_n)/\sigma_f(90°,E_n)$ was studied during the fission of Pu^{240} and Pu^{239} at bombarding neutron energies of 0.2 to 3.0 Mev. Four ionization fission chambers were used to detect the fission fragments simultaneously in the direction of the neutron beam and in a direction perpendicular to the neutron beam. The target consisted of a layer of Pu^{240}(1.5 mg) and a layer of Pu^{239} with a diameter of 32 mm. The source of fast neutrons was obtained from a T(p,n)He^3 reaction on a Van de Graaff generator. Two quantum states or fission channels were found for Pu^{240} at neutron energies of 0.9 to 1.0 Mev, and 1.6 to 1.7 Mev from the correlation in the irregularities of $\sigma_f(E_n)$ and $\sigma_f(0°,E_n)/\sigma_f(90°,E_n)$. The results of measuring the angular anisotropy from Pu^{239} which is a minimum at E_n = 0.8 Mev indicate that that there is a new fission channel in this region of energies. (TTT)

28484 HALF-LIFE OF Cs^{137}. M. P. Glazunov, A. I. Grivkova, B. A. Zaitsev, and V. A. Kiselev. Atomnaya Energ., 10: 622-3(June 1961). (In Russian)

The half-life of Cs^{137} was determined by measuring the change in count rate of a known amount of cesium. The count rate was taken on a 4π gas-flow counter, and the amount of cesium was measured on a MC-4 mass spectrometer by the method of isotopic dilution. The Cs^{137} was isolated from a mixture of fission products, and was 99.99% radiochemically pure. The average isotopic composition of the fission product cesium was found to be 49.36% Cs^{133}, 0.07% Cs^{134}, 14.01% Cs^{135} and 36.56% Cs^{137}. It was assumed that 11.4% correction had to be made for the conversion electrons from Ba^{137m}. The relative content of Cs^{134} and Cs^{137} was also determined radiometrically. The half-life of Cs^{137} was found to be 29 ± 1 years. (TTT)

28485 USE OF THE OPTICAL MODEL OF THE NUCLEUS FOR CALCULATING THE NEUTRON CROSS SECTIONS OF TUNGSTEN. V. A. Tolstikov, V. E. Kolesov, and V. S. Stavinskii. Atomnaya Energ., 11: 56-7(July 1961). (In Russian)

The complex potential model which was found to represent satisfactorily the interactions of neutrons with nuclei, was used for determining the individual components of the total cross section, in particular the inelastic scattering and the radiative capture cross sections, σ_{in} and $\sigma_{n,\gamma}$. These values and the cross section of the compound nucleus were computed for W^{186} in a wide neutron energy range, comparing the values obtained with experimental data from the literature. It was found that these theoretical values agreed well not only with the absolute values of $\sigma_{n,\gamma}$ but also duplicated its energy dependence, including the anomaly found in the 150-kev region where the rapid decrease of $\sigma_{n,\gamma}$ is due to competition with σ_{in} at the first energy level of W^{186}. The optical model is thus found useful for calculating the total cross section and its components when the target atom is in an excited state. (TTT)

28486 CROSS SECTIONS OF (p,pxn) REACTIONS IN Au^{197}. T. M. Kavanagh and R. E. Bell (McGill Univ., Montreal). Can. J. Phys., 39: 117-83(Aug. 1961).

Cross sections of (p,pn), (p,p2n), and (p,p3n) reactions in Au^{197} were measured by the activation method for incident proton energies up to 86 Mev. The curves of cross section as a function of energy have similar shapes for the three reactions. They rise from apparent thresholds at about 16, 21, and 30 Mev, respectively, to peak values of 180, 145, and 150 mb at proton energies about 30 Mev higher than the apparent threshold energies. The cross sections are much larger than those predicted from the statistical and cascade-evaporation theories, and they are interpreted in terms of two-body collisions in the diffuse surface of the target nucleus. A combination of these results with measured (p,xn) cross sections yields an approximation to the total reaction cross section of a heavy nucleus. (auth)

28487 THE RATIO OF THE RESONANCE INTEGRAL TO THE THERMAL NEUTRON CROSS SECTION FOR Sm^{152}. W. H. Walker and R. E. Green (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1184-92(Aug. 1961). (AECL-1272)

Cadmium ratio measurements were made in similar lattice positions in ZEEP with thin foils of Sm^{152} and gold. From a comparison of these cadmium ratios it is found that $(I'/g\sigma_0)_{Sm^{152}} = 14.65 \pm 0.41$. If $g\sigma_0$ is assumed to be 212 ± 12 barns, then I' = 3100 ± 200 barns. On the assumption that only one resonance in Sm^{152}, at 8 ev, contributes appreciably to both the resonance integral and the thermal cross section, it follows that g = 1 and that Γ, the width at half-maximum of the total cross section resonance, is 193 ± 5 milli-ev. Because of the appreciable disagreement between this value and one reported earlier, a new time-of-flight measurement of the resonance parameters was made. (auth)

28488 RESONANCE PARAMETERS FOR THE 8-ev LEVEL OF Sm^{152}. R. E. Chrien (Brookhaven National Lab., Upton, N. Y.). Can. J. Phys., 39: 1193-6(Aug. 1961).

The joint BNL–AECL Fast Chopper Facility operating at the NRU reactor at Chalk River was used to determine the resonance parameters of the 8-ev level of Sm^{152}. Using a resonance shape analysis method, the following parameters were obtained: E_0 = 8.02 ± 0.02 ev, Γ = 205 ± 15 milli-ev, and Γ_n = 79 ± 3 milli-ev. With these values, a reduced resonance capture integral of 3090 ± 220 barns is calculated, in agreement with recent cadmium ratio measurements. (auth)

28489 ANGULAR CORRELATION OF BETA-GAMMA COINCIDENCES IN THE COMPTON EFFECT. F. W. Van Name, Jr., and John W. Koch (Univ. of Delaware, Newark). Can. J. Phys., 39: 1212-15(Aug. 1961).

The Compton scattering equation for photons, $\cot \Phi = (1 + \alpha) \tan \frac{1}{2} \theta$, was verified for a variety of angles and with two different scattering targets. A Co^{60} source emitting 1.17 and 1.33 Mev gamma rays and beryllium and carbon targets were used. Data for all configurations used agreed with the above equation within ± 2° or better for both targets. (L.N.N.)

28490 THE HALF-LIFE OF Sm^{153}. R. E. Green and W. H. Walker (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1216-20(Aug. 1961). (AECL-1280)

Samarium-153 decay was measured by irradiation of superpure aluminum foil with Sm_2O_3 baked on in the ZEEP reactor or in the thermal column of the NRU reactor. The total error was calculated as ~0.2% giving a value of 46.2 ± 0.1 hours. This is 2% less than the value of Cork, et al., Phys. Rev. 110, p.526(1958). (L.N.N.)

28491 A NOTE ON SOME PROPERTIES OF HAMILTONIANS INVOLVING SPIN MATRICES FOR HALF-INTEGRAL VALUES OF I. G. M. Volkoff (Univ. of British

Columbia, Vancouver). Can. J. Phys., 39: 1226-32(Aug. 1961).

The spin-Hamiltonians involving odd or even powers of the components I_ξ of the spin operator $\vec{I}$ in the relations 1) $\mathcal{H}_z = -\vec{\mu} \cdot \vec{H} = -\gamma\hbar\vec{H}\vec{P} \cdot \vec{I}$ for the magnetic dipole (Zeeman) interaction of the nuclear magnetic moment $\vec{\mu} = \gamma\hbar\vec{I}$ with a given uniform external magnetic field $\vec{H} = H\vec{P}$ and 2) $\mathcal{H}_Q = -\tilde{Q} \cdot \vec{\nabla E} = C_1 [\phi_{zz}(3I_z^2 - \vec{I}^2) + (\phi_{xx} - \phi_{yy})(I_x^2 - I_y^2)] = C[(3I_z^2 - \vec{I}^2) + \eta (I_x^2 - I_y^2)]$ with $C_1\phi_{zz} \equiv C \equiv eQ\phi_{zz}/4I(2I-1)$, $\eta \equiv \phi_{xx} - \phi_{yy}/\phi_{zz}$ for the electric quadrupole interaction of the nuclear electric quadrupole and moment tensor $e\tilde{Q}$ with a given external electric field gradient $\nabla\vec{E} = -\nabla\nabla\phi$, are discussed. (L.N.N.)

28492 DIRECTIONAL CORRELATION OF THE 769-609 kev GAMMA-RAY CASCADE IN Po^{214}. H. W. Taylor and R. McPherson (Queen's Univ., Kingston, Ont.). Can. J. Phys., 39: 1235-9(Aug. 1961).

The 2+ spin assignment for the 1378-kev level in Po^{214} was checked, and the mixing ratio for the 769-kev gamma ray was determined. A coincidence spectrometer was used. The source material consisted of 30 μc of $RaCl_2$ in HCl in equilibrium with its decay products. The data confirm the suggestion that the 1378-kev level is the second 2+ level. The mixing ratio for the 769-kev γ is 95% quadrupole and 5% dipole radiation. (L.N.N.)

28493 LIFETIMES OF THE LOW-LYING LEVELS IN Ne^{20}. M. A. Clark, H. E. Gove, and A. E. Litherland (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1241-2(Aug. 1961). (AECL-1282)

Lifetimes of the 1.63-, 4.25-, and 4.97-Mev levels in Ne^{20} were measured by the Doppler shift attenuation method. Triply charged carbon ions of energies near 18 Mev were directed upon unbacked carbon targets and carbon targets evaporated on magnesium, aluminum, and copper foils. Gamma ray energies from Ne^{20} following the $C^{12}(C^{12},\alpha)Ne^{20*}$ reaction, were observed. The lifetimes found are ($\times 10^{-13}$ sec) $5.6^{+2.8}_{-1.2}$, $0.76^{+0.72}_{-0.52}$, and 19^{+35}_{-10} for the 1.63-, 4.25-, and 4.97-Mev levels, respectively. Slowing times and the ratio $|M|^2$ of the measured γ transition probabilities to the Weisskopf estimate for certain assumed multipolarities are also given. (L.N.N.)

28494 ALPHA-GAMMA ANGULAR CORRELATIONS IN THE REACTION $C^{12}(C^{12},\alpha)Ne^{20}$. H. E. Gove, A. E. Litherland, and M. A. Clark (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1243-5(Aug. 1961). (AECL-1281)

Angular correlations between gamma rays and alpha particles detected at 0° were measured in the reaction $C^{12}(C^{12},\alpha)Ne^{20}$ using 17-, and 18-Mev triply charged carbon ions. The detectors employed were p-n silicon junction counters. Previous spin assignment for the 4.97-Mev and 4.25-Mev levels and multipole mixing data for the 3.34-Mev level were confirmed and negative parity for the 3.34-Mev level was established. (L.N.N.)

28495 THE INTERPRETATION OF ANGULAR DISTRIBUTIONS AND ANGULAR CORRELATIONS FROM THE REACTION $C^{12}(C^{12},\alpha\gamma)Ne^{20}$. A. E. Litherland (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1245-6(Aug. 1961). (AECL-1294)

Angular correlation of the 1.63-Mev gamma ray following the 3.34-Mev unobserved gamma ray from the 4.97-Mev state in Ne^{20} was found to disagree with theory (Litherland, A. E., and Ferguson, A. J., Can. J. Phys. 39, 788(1961)). An explanation is given. (L.N.N.)

28496 MAGNETIC SPECTROMETER MEASUREMENTS OF LEVELS OF Ne^{20}. E. Almqvist and J. A. Kuehner (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1246-8(Aug. 1961). (AECL-1283)

Spectra of alpha particles from $C^{12}(C^{12},\alpha)Ne^{20}$ reactions were measured using a magnetic spectroscope. Data, including excitation energies in Ne^{20}, are given graphically. Preliminary evidence for new levels is presented with confirmation of some previously proposed. (L.N.N.)

28497 A 7.02-Mev LEVEL IN Ne^{20}. A. E. Litherland, M. A. Clark, and H. E. Gove (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1249-51(Aug. 1961). (AECL-1284)

A 7.02-Mev level in Ne^{20} was observed in a study of gamma-alpha coincidences from the reaction $C^{12}(C^{12},\alpha\gamma)Ne^{20}$. It has some of the properties expected for a 4-rotational level based on the 2-level in Ne^{20} at 4.97-Mev. The level was located by observing alpha particle spectra, in a 10^4 Ω cm silicon p-n solid state counter, in coincidence with gamma rays from Ne^{20} low-lying levels. The alpha counter was situated at 0° to the incident beam of C^{12} ions bombarding a 50 $\mu g/cm^2$ carbon foil. Three 0.4 mg/cm^2 aluminum foils were used to prevent the C^{12} ions from hitting the alpha counter. The gamma rays were observed with a 5-inch diameter by 6-inch long Na(Tl) crystal. (L.N.N.)

28498 SURVEY OF EXPERIMENTS ON THE POLARIZATION IN REACTIONS. W. Haeberli (Univ. of Wisconsin, Madison). Helv. Phys. Acta., Suppl., 6, 149-59 (1960).

Methods for detecting polarization of neutrons or protons in reactions are described. The availability of polarized neutrons at 0.2 to 8 Mev and the development of polarization measurement techniques are discussed. The importance of spin-orbit coupling is indicated. (L.N.N.)

28499 THE SCATTERING OF POLARIZED PARTICLES. H. H. Barschall (Univ. of Wisconsin, Madison). Helv. Phys. Acta, Suppl., 6: 227-38(1960).

Techniques for measuring the polarization of scattered protons, neutrons, and electrons are compared. Apparatus diagrams and graphical presentations of data are given. (L.N.N.)

28500 POLARIZATION PHENOMENA IN DEUTERON STRIPPING REACTIONS. L. C. Biedenharn (Duke Univ., Durham, N. C.) and G. R. Satchler. Helv. Phys. Acta., Suppl. 6, 372-401(1960). (In English)

Polarization phenomena in the usual theory of (d,p) reactions (i.e., the distorted wave Butler theory without explicit spin-orbit coupling) are shown to have a common origin, which is in effect simply a measurement of the neutron transfer angular momentum direction (multiplied by quantum geometrical factors). Limitations implied by this result are discussed. The effect of explicit spin-orbit couplings is discussed for the important case where the transfer angular momentum is zero. It is shown that for this case the proton polarization is approximately given by the derivative of the (unpolarized) angular distribution. Symmetry considerations in the distorted wave Butler theory are discussed and illustrated by application to Coulomb effects. Numerical examples are cited to illustrate the qualitative predictions of the discussion. (auth)

28501 IONIZATION LOSSES AND CAPTURE OF SLOW, HEAVY, NEGATIVE PARTICLES. I. I. Gol'dman (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 14: No. 1, 79-85(1961). (In Russian)

The slowing-down of a charged particle in a substance is

well described by the equation of Bethe-Bloch in the region of velocities of $v \gg v_0 = e^2/h$. Experiment shows that at $v < 2v_0$ the ionization losses fall off rapidly. However, capture of a negative particle at an external atomic shell can serve as an additional loss mechanism for negative particles at low velocities. By introduction of a parameter $\rho = M/\sqrt{2\mu}\,E$, which does not depend on the mass μ (M is the momentum and E is the energy), equations are developed that show that the cross-section for the ionization of the negative particle does not depend on the mass. The negative particle loses energy equal approximately to the ionization potential I for absorption in a gas. At very low energies, capture takes place if $E \sim I$, and the capture probability is not sensitive to Z. At large values of Z the calculations must be modified to take into account the nuclear screening. (TTT)

28502 INTERNAL CONVERSION WITH PAIR FORMATION AT A POLARIZED NUCLEUS. S. M. Darbinyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Fiz.-Mat. Nauk, 14: No. 2, 92-102(1961). (In Russian)

Since parity is not conserved in beta decay, the nucleus obtained after a beta decay remains polarized with respect to the direction of emission of the beta particle. Hence, the particles, resulting from an internal conversion which occurs after beta decay, should also be polarized. Average values of the polarizations of conversion electrons and positrons, and the conversion coefficient for pair formation at a polarized nucleus are presented in detailed mathematical form. The effect of the coulomb field is not taken into account. (TTT)

28503 THEORY OF RELATIVISTIC PARTICLE SCATTERING BY NUCLEAR COULOMB FIELD. I. I. Guseinov. Izvest. Akad. Nauk Azerbaidzhan. S.S.R. Ser. Fiz.-Mat. i Tekh. Nauk, No. 2, 61-4(1961). (In Russian)

The problem of electron scattering by nuclear Coulomb fields in non-relativistic classical mechanics results in a Reserford formula. An attempt is made to analyze the problem with consideration for relativistic effects. (R.V.J.)

28504 ANALYSIS OF SECOND FORBIDDEN β SPECTRA. M. Vindushka and L. N. Zyryanova. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 52-5(Jan. 1961). (In Russian)

The non-unique, second forbidden β spectra ($\Delta I = 2$ is not found) are analyzed on the basis of A–V interactions. The magnitudes of nuclear parameters describing spectral shapes are developed. Spectral forms are given for Cl^{36}, Fe^{59}, Cs^{135}, and Cs^{137}, and the magnitudes for lg f_0t and lg f_2t for β transitions are tabulated for Cl^{36}, Sc^{46}, and Tc^{99}. (R.V.J.)

28505 SYSTEMATIC CALCULATION OF LIFETIMES FOR VARIOUS β TRANSITIONS. L. N. Zyryanova and V. M. Mikhailov. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 56-60(Jan. 1961). (In Russian)

The magnitudes of ft are calculated for 1100 β transitions selected because their characteristic data are more accurate. Most of the ft values were calculated on the basis of permitted transitions. In cases of orbital electron capture, ft was calculated using f_K and f_L, and considering their effects. Differences in the spectral shape from statistical were considered in unique β transitions. The data are developed using a large accumulation of statistical material, allowing a more accurate determination of lg ft distribution. The histograms for permitted and forbidden β transitions are plotted and mean values for lg ft are tabulated. (R.V.J.)

28506 INTERNAL PAIR FORMING CONVERSION IN Ta^{182} DECAY. S. S. Vasilenko, M. G. Kaganskii, D. L. Kaminskii, and S. F. Koksharova (Inst. of Physics and Tech., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 61-7(Jan. 1961). (In Russian)

Data on intrinsic conversions with pair formation were used in studies of energy transitions exceeding 2 mc^2. Such transitions pass through an energy "slit." The energy levels of W^{182} are plotted and transitions between rotation bands with $K = 2^-$ and $K = 0^+$ are analyzed. The spectra of pair conversion positrons and electrons were measured with a β spectrometer using an irradiated tantalum oxide source. The resolving power was 1.8%. The data on transition multiplicity show that for 1122 kev the $(\Gamma/\alpha K)_{exp}$ is in good agreement with E2 with a slight admixture M1. The transition at 1188 kev is mixed 75% E1 + 25% M2. The 1222 kev transition is E2, which agrees with published data. The 1231 kev transition is E2 with a small admixture M1. An E1 assigned to 1256 kev differs from that calculated, indicating a large error in determining the K line. The data for the 1275 kev transition indicate mixed transitions. This agrees with previous data when the mixture is 80% E1 + 20% M2. The multiplicity of the 1290 kev transition was found to be of M2 and E3 type or even higher. Previous data for 1290 kev show the relative intensity 5 ± 2, while the obtained data indicate 3.3 for the M2 and 10.2 for E3. (R.V.J.)

28507 DETERMINATION OF α_k IN Pr^{141} TRANSITION AT 143 kev BY 4 π SCINTILLATION SPECTROMETER. L. Nemet. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 68-9(Jan. 1961). (In Russian)

The number of KX quanta following internal conversion was compared with the number of γ quanta with a 4π-spectrometer with a CsI–Tl crystal (the efficiency was nearly 100%). Under favorable conditions ($E_\gamma < 200$ kev) the order of error is ~2%. The method was applied in determining the coefficient of internal conversion for the $E_\gamma = 143$ kev transition in $Ce^{141} \xrightarrow{\beta^-} Pr^{141}$. The spectrum of γ and KX rays was plotted; the results show $\alpha_K = 0.375 \pm 0.006$. (R.V.J.)

28508 COULOMB EXCITATION OF ENERGY LEVELS OF P^{31}, S^{33}, Mn^{55}, AND Pr^{141} BY MEANS OF Ne^{20} IONS. D. S. Andreev, A. P. Grinberg, K. I. Erokhina, and I. Kh. Lemberg (Inst. of Physics and Tech., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 70-6 (Jan. 1961). (In Russian)

A scintillation spectrometer with a NaI-Tl crystal 40 mm in diameter and 40 mm thick was used in an investigation of energy levels at 1.26 (P^{31}), 0.84 (S^{33}), 0.98 (Mn^{55}), and 0.142 Mev (Pr^{141}). Tetracharged ions of Ne^{20} were used in the Coulomb excitations. Gamma energies, the probability of electrical quadrupole excitation levels, the partial lifetimes of levels related to the electrical quadrupole nuclear transitions to the ground states, and the level lifetimes are tabulated and analyzed. (R.V.J.)

28509 PROBABILITIES OF γ TRANSITIONS IN ODD-ODD DEFORMED NUCLEI. D. A. Varshalovich (Inst. of Physics and Tech., Academy of Sciences, USSR). Izvest. Akad. Nauk, S.S.S.R., Ser. Fiz., 25: 77-82 (Jan. 1961). (In Russian)

An analysis is made of cases in which residual interaction p and n is small, $\alpha_1^2 < \alpha_0^2$, and the levels of the odd-odd nucleus can be determined by known quantum state values Ω_p^π, Ω_n^π and K. With such classification the γ transitions in odd-odd nuclei can be divided into three groups: (1) Transitions between the levels of a single rotation band; $\Omega_p^1 = \Omega_p^2$; $\Omega_n^1 = \Omega_n^2$; and $K^1 = K^2$. (2) Transitions between the doublet levels or their rotation bands; $\Omega_p^1 = \Omega_p^2$; $\Omega_n^1 = \Omega_n^2$; and $K^1 \neq K^2$. (3) Transitions between different doublets; single

sign $\Omega_\alpha^1 \neq \Omega_{\bar{\alpha}}^2$; $\Omega_\beta^1 = \Omega_{\bar{\beta}}^2$; and $K^1 \neq K^2$; and double sign $\Omega_\alpha^1 \neq \Omega_{\bar{\alpha}}^2$; $\Omega_\beta^1 \neq \Omega_{\bar{\beta}}^2$; and $K^1 \neq K^2$. All three types of transitions are investigated. The magnetic moments for ground states of rotation bands (K = 1) and the probabilities of M1 γ transitions ($I_1 = K + 1 \rightarrow I_2 = K$) are tabulated for odd-odd Na, Al, Eu, Tb, Ho, Tm, Lu, Ta, Re, and Ir isotopes. Measurements were made of magnetic moments of deformed odd-odd Na^{22}, Na^{24}, Al^{26}, Eu^{152}, Eu^{154}, and Lu^{176}. The theoretical and experimental magnitudes for Eu^{152} and Eu^{154} differ about 30%; values for the other nuclei are in good agreement. (R.V.J.)

28510 ELECTROMAGNETIC TRANSITIONS OF DEFORMED NUCLEI. Yu. N. Gnedin (Inst. of Physics and Tech., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 83-9(Jan. 1961). (In Russian)

Correlations of experimental data with theoretical analyses of radiative transitions, calculated according to spherical and generalized models, are tabulated for Dy^{161}, Tm^{169}, Lu^{175}, Lu^{177}, Ac^{227}, Pa^{231}, Np^{237}, Pu^{239}, Eu^{153}, Ta^{181}, Ir^{191}, W^{181}, Mo^{163}, Dy^{165}, Er^{167}, Pu^{237}, Os^{191}, Re^{187}, Hf^{178}, and W^{179}. The best agreement was observed for high multiplicity electromagnetic transitions. Due to inaccuracies in adiabatic approximations describing real nuclei the multipole moments related to collective nuclear motion are reduced and transitions become almost single term. In the case of electric transitions the data for E3 transitions are in good agreement with experiment. (R.V.J.)

28511 INVESTIGATION OF THE Gd^{146}, Gd^{147}, AND Gd^{149} DECAY SCHEMES BY MEANS OF $\beta-\gamma$ COINCIDENCE SPECTROMETER. E. E. Berlovich, O. V. Larionov, E. N. Tunimanova, and D. M. Khai (Ioffe Inst. of Physics and Tech., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 90-7(Jan. 1961). (In Russian)

The cascade transitions in Gd^{146}, Gd^{147}, and Gd^{149} were analyzed in order to verify the decay scheme details for Eu^{147} and Eu^{149} in which the transitions at 298 kev and 370 kev cannot be fitted into the Mayer's model frame. The decay schemes for Gd^{146}, Gd^{147}, and Gd^{149} are shown and the peaks of K electron coincidences with γ rays are plotted. The 298 kev transition in Eu^{149} was observed in cascade with 346 and 149.8 kev transitions and is found over the isomer level emerging from the 795 kev level. The data on coincidences are in good agreement with previously published decay schemes. (R.V.J.)

28512 DETERMINATION OF ELECTRON CAPTURE PROBABILITIES FROM L AND K SHELLS IN Cr^{51}, Zn^{65}, AND Ge^{71} DECAY. A. A. Konstantinov and V. V. Perepelkin. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 106-8 (Jan. 1961). (In Russian)

A proportional 4π counter, using the coincidences between KX quanta and Auger L electrons, was used for determining λ_L/λ_K in Cr^{51}, Zn^{65}, and Ge^{71}. The λ_L/λ_K probability ratios are tabulated. (R.V.J.)

28513 DECAY OF Dy^{159}. E. I. Biryukov, O. I. Grigor'ev, B. S. Kuznetsov, and N. S. Shimanskaya (Khlopin Radium Inst., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 109-10(Jan. 1961). (In Russian)

A proportional counter and a γ scintillation spectrometer were used in studies of electromagnetic emission from Dy^{159} (T = 44 days) prepared by tantalum target bombardment by 660-Mev protons. The spectrum of Dy^{159} emission at 15 to 60 kev, taken by proportional counter with 130 mg cm^{-2} Al filter, is plotted. The non-converted γ radiation with E = 58 kev is 6.1%; this agrees with the data on Gd^{159} γ decay. The intensity of the observed weak line at 350 kev was 5×10^{-5} quanta per decay. For transition to the first excited level of Tb (58 kev), considering L fluorescence as $\bar{\omega} = 0.18 \pm 0.02$, the ratio L_1/K_1 is 0.56 and κ is 0.32 ± 0.08. (R.V.J.)

28514 REACTION (d,t) ON O^{16}, O^{18}, Mg^{27}, Mg^{25}, AND Mg^{26} NUCLEI. N. A. Vlasov, S. P. Kalinin, A. A. Ogloblin, and V. I. Chuev (Kurchatov Inst. of Atomic Energy [USSR]). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 115-20(Jan. 1961). (In Russian)

The nuclei under investigation have saturated 1 s and 1 p shells and different numbers of neutrons in the 1 $d_{5/2}$ to 1 $S_{1/2}$ shells. Configurations for the simplest nuclei, O^{18} and F^{16}, were calculated previously and are verified by correlation with transition probability data on O^{18} (d,t) O^{17} reactions. Magnesium isotopes are studied in relation to the observed rotational spectrum structure and assumed nuclear elongation. Typical triton spectra from each target are given. A strong group of tritons from reactions on O^{16} at $E_t = 10.5$ Mev was observed in addition to that for O^{18}. The $Mg^{25}O$ and $Mg^{26}O$ contained small admixtures of carbon, and a group of tritons from C^{12} (d,t) C^{11} was observed at $E_t \approx 7$ mev. The order of error for absolute cross section magnitudes for Mg^{24} and Mg^{26} is 20% and for O^{18} and Mg^{25} is 25%. The four groups of tritons observed in O^{18} (d,t) O^{17} correspond to the ground state and three excited states of O^{17} at 0.87, 3.06, and 5.3 Mev. The angular distributions of these four groups and of the groups from Mg^{25} (d,t) Mg^{24} are plotted. The differential cross section of O^{16} (d,t) O^{15} was also examined, and as had been expected, the neutron was knocked out of O^{16} at l = 1. (R.V.J.)

28515 THERMAL NEUTRON REACTION (n,α) IN Pu^{239}. V. N. Andreev. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 121-3(Jan. 1961). (In Russian)

The thermal neutron reaction $Pu^{239}(n,\alpha)$ U^{236} was analyzed. The scheme of the experimental installation is described. The thermal neutron beam from a heavy water reactor was directed onto Pu^{239} coated with aluminum foil of surface density 1 mg cm^{-2}. A proportional counter was used for recording α particles. The cross section for the (n,α) reaction with α particle emission $E_\alpha = 11.4$ Mev, is ~ 20 mb; this corresponds to $\Gamma_\alpha \approx 2 \times 10^{-6}$ ev($\Gamma_\gamma \approx 4 \times 10^{-2}$ ev). The result was correlated with quasi-classical α decay theory. The experimental ratio of Pu^{240*} and Pu^{240} decay constants is $(\lambda^*/\lambda)_{exp} = 10^{21}$. The scheme of $E_\alpha = 11.4$ Mev transition is given. It is shown that 0^+ or 1^+ states are formed in Pu^{239} thermal neutron capture when the parity of Pu^{239} is positive and 1^- state when the parity is negative. The transition from 1^+ to the U^{236} ground state is forbidden, therefore, the transition $E_\alpha = 11.4$ Mev is at the 49.6 kev level. (R.V.J.)

28516 HEAVY ATOM MASS AND BOND ENERGY OF NUCLEI IN THE $174 \leq M \leq 239$ REGION. R. A. Demirkhanov, T. I. Gutkin, and V. V. Dorokhov. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 124-9(Jan. 1961). (In Russian)

Measurements were made with a double-focusing, 50000 to 80000 resolving power mass spectrometer using the doublet method for heavy nuclei. Organic compounds of C_nH_m, $C_nC^{13}H_m$, $C_nN_mH_k$, and $C_nO_mN_kH_p$ were used as mass standards. Mass data for 42 stable isotopes were utilized in developing a relation for bond energy per nucleon in the range $174 \leq M \leq 210$. The curve of nucleon bond energy confirms the presence of a shell structure with a saturated shell at Z = 82 and N = 126 and clearly exhibits the nucleon bond energy difference in nuclei with even and odd mass. The nucleon bond energy for odd-A is always smaller than for nuclei with even A at Z = const. The results are correlated with published data, and discrepancies are analyzed. (R.V.J.)

28517 CORRELATION AND SYSTEMATICS OF BINDING ENERGY OF HEAVY NUCLEI FROM HAFNIUM TO FRANCIUM. V. A. Kravtsov (Leningrad Polytechnic Inst.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 130-8(Jan. 1961). (In Russian)

Corrections and verifications of data on reaction energy are given for heavy nuclei from hafnium to francium. The correlation is made using closed cycles, the experimental data chain, surface energy cross sections, and reaction and decay energies. For the reaction $Pt^{194}(\gamma,n)Pt^{193}$, calculated by the mass difference, Q = 8.32 ± 0.15 Mev. For the reaction $Tl^{203}(\gamma,n)Tl^{202}$, Q is 7.76 ± 0.30 Mev. Corrected and verified data on reaction energy and β decay energy are tabulated and discussed. The isotopic cross sections of energy surfaces with reduced deflection are given for even-even and odd-odd Z. The obtained data confirmed postulations on the influence of nuclear shells on the energy surfaces of heavy nuclei. Curves for the energy surface cross sections are more uniform. The energy of proton breakaway B_p is plotted as a function of the number of protons in the nucleus Z, and the neutron pair energy P_n is plotted as a function of the number of neutrons in even-even and odd-odd nuclei. (R.V.J.)

28518 SCATTERING OF FAST NEUTRONS BY NONAXIAL NUCLEI. V. I. Belyak(Lebedev Inst. of Physics [Moscow]). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 139-42(Jan. 1961). (In Russian)

Neutron scattering by nonspherical nuclei at small angles is analyzed in $kR \gg 1$ approximation. In the approximation the wave function of the system in the half-space $Z \geq 0$ (Z = 0 is the plane passing through the nucleus perpendicularly to the flux of incident particles) satisfies the Schroedinger equation $(T_r + T_\omega)\Psi(r,\omega) = 0$, when T_r is the kinetic energy operator of scattered particles, T_ω is the nuclear rotation energy operator. The measurement of incident particle interactions is achieved by superimposing the boundary condition on the wave function in the plane Z = 0. (R.V.J.)

28519 DETERMINATION OF HALF LIFE OF EXCITED STATES FOR U^{235} FISSION PRODUCTS. B. M. Shiryaev (Khlopin Radium Inst., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 143-4(Jan. 1961). (In Russian)

The mean half life of fragment excited states, determined in relation to γ-quantum emission and based on solid angle measurements, was found to be within the range (0.5 to 2.0) × 10^{-9} sec. The results are in good agreement with published data and confirm the postulation that γ rays are emitted mainly following neutron evaporation from excited fragments. (R.V.J.)

28520 POLARIZATION CORRELATION IN ELECTRON-POSITRON PAIR FORMATION, CONSIDERING FINITE DIMENSIONS OF THE NUCLEUS. B. K. Kerimov and F. S. Sadykhov (Moscow State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 166-8(Jan. 1961). (In Russian)

The influence of finite nuclear dimensions and the angle of positron emission on the effective cross section of longitudinally-polarized electron–positron pair formation is studied. The developed formula for the cross section is applied in an investigation of the effect of nuclear expansion on the angular and longitudinal electron–positron spin correlation in pair formation processes. (R.V.J.)

28521 THE NON-ELASTIC NEUTRON CROSS-SECTION FOR URANIUM AT 13–19 MeV AND BERYLLIUM AT 14 MeV. A. V. Cohen (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 14: 180-5(July 1961).

The nonelastic cross sections of uranium and beryllium have been measured for neutrons of 14.08 Mev using a sphere absorption technique. The results are: U, 2.89 ± 0.05 barns; and Be, 0.50 ± 0.035 barns. The cross section for inelastic scatter to the Be level at 2.43 Mev is 0.20 ± 0.045 barns. The variation with energy of the nonelastic cross section of uranium has also been investigated, using neutrons from 13.35 Mev to 18.54 Mev. (auth)

28522 RESONANCE ABSORPTION IN Pu^{239} AND ITS EFFECT ON THE TEMPERATURE COEFFICIENT OF IRRADIATED URANIUM RODS. M. H. McKay (General Electric Co. Ltd., Erith, Kent, Eng.). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 14: 200-8(July 1961).

The effective resonance integral for both fission and radiative capture is first calculated for different-sized rods of pure Pu^{239} at various temperatures in a graphite-moderated lattice. Then the contribution from Pu^{239} to the effective resonance integral of irradiated uranium rods in a graphite moderator is evaluated for the same rod sizes and temperatures, concentrations of 0.15 per cent and 0.2 per cent Pu^{239} being considered in turn. The fuel temperature coefficient is estimated at both concentrations and compared to the temperature coefficient of the same rods at zero irradiation. The fractional change in fuel temperature coefficient due to Pu^{239} build-up is found to be small, in the absence of any allowance for neutron spectrum distortion in the region of the lowest Pu^{239} resonance, due to neutron thermalization. (auth)

28523 A DIRECT METHOD FOR THE EVALUATION OF THE RESONANCE LINE SHAPE FUNCTIONS. F. T. Adler and Y. D. Naliboff (Univ. of Illinois, Urbana). J. Nuclear Energy, Pts. A and B. Reactor Sci. and Technol., 14: 209-11(July 1961)

The determination of the line shape functions ψ and χ describing the Doppler broadening of neutron cross sections often requires lengthy numerical calculations. A direct method is presented for calculating ψ and χ which is significantly faster for computer applications than procedures currently in use. The functions may be used in the usual prescriptions, or in a more accurate one based on the reaction rate. (auth)

28524 DECAY OF Rh^{102} AND LEVELS IN Ru^{102}. Kazuo Hisatake (Tokyo Inst. of Tech.). J. Phys. Soc. Japan, 16: 1280-91(July 1961). (In English)

The decay of Rh^{102} was investigated using scintillation spectrometers and a magnetic beta-ray spectrometer. The negatron spectrum has the end-point energy of 1.15 Mev and the positron spectrum consists of two groups of end-point energies of 1.30 Mev and 0.82 Mev. All of beta-spectra involved appear to have approximately "the allowed shape of the Fermi plot". Twelve gamma transitions were assigned to Ru^{102} from the internal conversion spectrum and the single and coincidence gamma-ray spectra. Gamma-gamma angular correlations were also measured. The results are consistent with the following level scheme for Ru^{102}: 0.476 (2+), 1.106(2+), 1.53(3+), 1.85(?), 1.87(1+, 2+, or 3+), 2.06 (?), and 2.23(3–) Mev. The transition between the first and second 2+ state was found to consist primarily of E2 transition. The branching ratio obtained for the cascade to crossover transition from the second 2+ level is (4.2 ± 0.8). (auth)

28525 THE SECOND EXCITED STATE OF Sn^{120}. Mitsuhiro Kawamura (Kyoto Prefectural Univ.), Atsushi

Aoki, and Hidetsugu Ikegami. J. Phys. Soc. Japan, 16: 1493-7(Aug. 1961). (In English)

The directional correlation and the polarization-direction correlation of the 1.03–1.17 Mev gamma-gamma cascade in Sn^{120} were measured. It is found that the spin and the parity of the second excited state of Sn^{120} is 4 and even, respectively. (auth)

28526 NUCLEAR GROUND-STATE ENERGIES. Masami Yamada (Waseda Univ., Tokyo) and Zyun-itiro Matumoto. J. Phys. Soc. Japan, 16: 1497-1529(Aug. 1961). (In English)

The proton and neutron separation energies and the β decay energies are estimated for most nuclei. In this estimation four semi-empirical rules for the proton and neutron separation energies are used in addition to the available experimental data. These rules are also used to eliminate the wrong data and to correct the wrong interpretations of the experimental results. The "best" values thus obtained are tabulated. Explanations are given for some of the data which are eliminated or need large adjustments. (auth)

28527 THE $N^{14}(d,\alpha)C^{12}$ GROUND-STATE REACTION IN THE ENERGY RANGE OF DEUTERON FROM 1.5 TO 3.0 MEV. Toshiyuki Ishimatsu (Kyusyu Univ., Japan). J. Phys. Soc. Japan, 16: 1529-38(Aug. 1961). (In English)

The angular distribution for the $N^{14}(d,\alpha)C^{12}$ ground-state reaction was obtained at seven deuteron energies between 1.5 and 3.0 Mev, and the excitation function for this reaction at the laboratory angle of 30° was determined in the same energy range. The angular distribution varies remarkably with deuteron energy, suggesting that the reaction proceeds mainly via compound nucleus formation. The energy dependence of the 30°-differential cross section and the total cross section indicate the presence of overlapping resonances at the excitation energy of about 22.6 Mev in the compound nucleus, O^{16}. (auth)

28528 LEVEL STRUCTURE OF Nd^{144}. Kazusuke Sugiyama, Akira Furusawa, Shogo Hayashibe, and Motoharu Kimura (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 16: 1538-43(Aug. 1961). (In English)

The energies and spins of lower excited levels in Nd^{144} were established by studies of the beta decay of $Ce^{144}-Pr^{144}$ and the electron capture decay of Pm^{144}. The experiments include energy and relative intensity measurements and directional correlation measurements of gamma rays by several NaI(Tl) scintillation counters. The level of Nd^{144} is populated at 695 kev and 2190 kev from decay of Pr^{144} and at 695, 1310, and 1780 kev from the decay of Pm^{144}. The levels at 1220 and 1560 kev which have been found by neutron capture gamma ray measurements could not be found. (auth)

28529 SPIN ECHOES OF Co^{59} IN fcc COBALT METAL. Kiyoshi Sugibuchi, Motohiro Matsuura, and Tsuneo Hashi (Kyoto Univ.). J. Phys. Soc. Japan, 16: 1648(Aug. 1961). (In English)

Spin echoes of cobalt-59 in ferromagnetic cobalt metal were experimentally investigated by the pulse method. The pulse width used was 2 μsec or less at 77 to 300°K. Measurement of the spin-lattice relaxation time is discussed and the strong spin-echo signals detected are represented graphically. (L.N.N.)

28530 INTERACTION OF 14-MEV. NEUTRONS WITH SILICON SEMICONDUCTOR NUCLEAR PARTICLE DETECTOR. W. M. Deuchars and G. P. Lawrence (Australian National Univ., Canberra). Nature, 191: 995(Sept. 2, 1961).

A silicon surface barrier detector was irradiated with neutrons of 14.03 ± 0.05 Mev from the reaction $T(d,n)He^4$. Assuming that reactions induced in Si^{28} are the most important, the possible charged-particle emitting reactions are $Si^{28}(n,p)Al^{28}$, $Q = -3.86$ Mev; $Si^{28}(n,\alpha)Mg^{25}$, $Q = -2.66$ Mev; and $Si^{28}(n,d)Al^{27}$, $Q = -9.36$ Mev. The expected energy of proton groups corresponding to the first seven levels in Al^{28} and α groups corresponding to the first fifteen levels in Mg^{25} were calculated. Results of cross section measurements made for the α groups to the first five levels of Mg^{25} are given. (P.C.H.)

28531 CIRCULAR POLARIZATION OF γ-RAYS FOLLOWING THE CAPTURE OF POLARIZED NEUTRONS. J. Vervier (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Phys., 26: 10-34(1961). (In English)

The circular polarization of γ rays following the capture of polarized neutrons was measured for some high-intensity transitions in S^{33}, Ti^{49}, Fe^{57}, Ni^{59}, Y^{90}, Al^{28}, Cu^{64}, and N^{15}. The results are consistent with spin $\frac{1}{2}$ for the 0.46 Mev level in Ni^{59} and spin 2 for the 0.277 Mev level in Cu^{64}. The following spins are confirmed: $\frac{3}{2}$ for the 3.22 Mev level in S^{33}; $\frac{3}{2}$ and $\frac{1}{2}$ for the 1.38 and 1.72 Mev levels in Ti^{49}; 2 for the 0.777 Mev level in Y^{90}. In N^{15}, (25 ± 18)% of captures are found to occur in a state with spin $\frac{1}{2}$. In Fe^{57}, (49 ± 19)% of the intensity of the 7.64 Mev doublet γ-ray is found to belong to the ground state transition. In Al^{28}, information is obtained relating the mixture of spins in the capturing state and multipole mixtures and relative intensities of the components of the 7.72 Mev doublet. The results are compared with the predictions of nuclear models and theories of thermal neutron capture. (auth)

28532 ENERGY LEVEL SHIFTS IN ATOMIC STATES OF STRONGLY-INTERACTING PARTICLES. T. L. Trueman (Univ. of Chicago). Nuclear Phys., 26: 57-67(1961). (In English)

The energy-level displacements for atomic states of two oppositely-charged nuclear particles due to their strong interactions are related to the parameters of the effective range approximation for the low-energy scattering of these two particles. For s- and p-states, the level shift and width are obtained to third order in A/B (scattering length A divided by Bohr radius B). The results are illustrated by a brief discussion of the level shifts and lifetimes of the K^--p and K^--d systems. (auth)

28533 OCTUPOLE VIBRATIONS OF DEFORMED EVEN NUCLEI. P. O. Lipas and J. P. Davidson (Rensselaer Polytechnic Inst., Troy, N. Y.). Nuclear Phys., 26: 80-90 (1961). (In English)

To explain the systematic occurrence of K = 0– and K = 2– bands in deformed even nuclei, the nuclear surface is assumed to have two octupole degrees of freedom, corresponding to the spherical harmonics Y_{30} and $Y_{3\pm2}$, in addition to the β and γ quadrupole degrees of freedom. An approximate Hamiltonian, valid for small oscillations about a spheroidal equilibrium shape, is constructed with the hydrodynamic moments of inertia. Separation of the Schrödinger equation immediately gives β vibrations (K = 0+, I = 0, 2, 4,...) and "b vibrations" (K = 0–, I = 1, 3, 5,...). The remaining equation is solved formally as a degenerate perturbation problem. The result gives rise to two bands with K = 2, which are interpreted as the γ vibrational band (K = 2+) and a "g vibrational band" (K = 2–), both with spin sequence I = 2, 3, 4,... The theory is consistent with experiment in the strongly deformed regions. (auth)

28534 A CLUSTER MODEL REPRESENTATION FOR THE 3-BODY GROUND STATE. James E. Young and Paul R. Stein (Los Alamos Scientific Lab., N. Mex.). Nuclear Phys., 26: 97-107(1961). (In English)

The representation of the 3-body ground state as a deuteron plus extra particle is considered. Calculations in this model are done in a very approximate way. In particular, the actual Hamiltonian of the system is not diagonalized in any order. The "model" Hamiltonian containing the chosen nuclear correlations is, of course, utilized properly. Calculations of the magnetic moment and Coulomb radius for the specific model are given. The latter result, plus that arising from diagonalization of the "model" Hamiltonian and wave function normalization, furnishes a set of three equations. In the analogous intermediate coupling expansion of the ground state, there are an equal number of admixture coefficients to be determined. Basis wave functions in the deuteron and extra particle are given. These are generated by a separable, non-local potential and are particularly well-suited for eventual diagonalization of the actual Hamiltonian through a variational principle. (auth)

28535 YIELD RATIOS OF THE ISOMERIC PAIR $Ce^{137m/137}$ FORMED BY $La^{139}(d,4n)Ce^{137}$ REACTION. H. Vignau and S. J. Nassiff (Universidad Nacional, La Plata, Argentina and Comisión Nacional de Energía Atómica, Buenos Aires). Nuclear Phys., 26: 108-12(1961). (In English)

The variation of the yield ratio between the isomeric pair formed in the reaction $La^{139}(d,4n)Ce^{137m/137}$ for deuteron energies up to 27 Mev was measured. (auth)

28536 A SEARCH FOR AN ISOMERIC STATE IN Mn^{54}. O. Dietzsch, R. A. Douglas, and Violeta Gomes (Universidade, São Paulo, Brazil). Nuclear Phys., 26: 113-16 (1961). (In English)

An attempt was made to detect the 2 min isomeric state in Mn^{54} reported by Caldwell and Stoddart and by Elwyn et al. A study was made of activities following the gamma irradiation of Mn^{55} targets and the proton bombardment of a natural chromium target. No activity with half life 2 ± 1.5 min was found which could be attributed to Mn^{54}. From these experiments it is concluded that there is insufficient evidence to establish the existence of the isomeric state in Mn^{54}. (auth)

28537 ISOBARIC-SPIN RELATIONSHIPS BETWEEN NUCLEAR SPECTRA. J. B. French (Rijksuniversiteit, Utrecht and Univ. of Rochester, N. Y.). Nuclear Phys., 26: 161-7(1961). (NYO-9366). (In English)

The simple fact that a one-body energy describes the interaction of a nucleon with a closed neutron subshell is used to establish sets of equations connecting the spectra of nuclei which are related by isobaric-spin when described by means of the nuclear shell model. Certain formal questions about isobaric spin are incidentally considered. (auth)

28538 ISOBARIC-SPIN SPLITTING OF SINGLE-PARTICLE RESONANCES. J. B. French (Rijksuniversiteit, Utrecht and Univ. of Rochester, N. Y.) and M. H. MacFarlane. Nuclear Phys., 26: 168-76(1961). (NYO-9367). (In English)

When a single proton is added to, or a single neutron removed from, a definite shell-model orbit in a target nucleus, the total strength can in general be divided into two parts, each part being characterized by a definite value of the isobaric spin T. This separation is pertinent even when the target isobaric spin is a redundant quantum number determined simply by the neutron excess, and probably in many cases when the isobaric spin is not conserved in the individual states which contribute to the strength. General expressions are given for the total strengths and for the strengths of the T-components. The practical problem of observing this effect as a T-splitting of giant resonances is discussed briefly. (auth)

28539 CROSS SECTIONS OF THRESHOLD REACTIONS FOR FISSION NEUTRONS: NICKEL AS A FAST FLUX MONITOR. T. O. Passell and R. L. Heath (Stanford Research Inst., Menlo Park, Calif. and Phillips Petroleum Co., Idaho Falls, Idaho). Nuclear Sci. and Eng., 10: 308-15(Aug. 1961).

Measured values of effective cross sections for fission neutrons obtained for (n,p) reactions on Ni^{58}, Fe^{54}, Zn^{64}, Mg^{24}, Fe^{56}, Zn^{67}, and Cu^{65} are 92, 54, 28, 1.2, 0.82, 0.57, and 0.36 mb, respectively. All cross sections are based upon the value 0.60 mb for the (n,α) reaction on Al^{27}. Measurements are made at the exact center of the EBR-I core. This position is to have a neutron energy spectrum similar to that of virgin fission neutrons in the region above 2 Mev. The (n,p) reaction on Ni^{58} is shown to have unusual practical advantages as a fast flux monitor. The chemical and physical stability of nickel metal in most reactor coolants, the absence of radioactivities obscuring the daughter Co^{58}, the long half life of Co^{58} (72 days), and the ease with which its 0.800 Mev gamma can be measured, are some of these advantages. A major but avoidable drawback is the 1650 barn thermal neutron capture cross section of Co^{58}. A comparison of nickel and sulfur in measuring fast neutron flux spectra is included. Evidence is presented that indicates that the fission neutron cross section of S^{32} is 65 mb. (auth)

28540 MEASUREMENTS OF RELATIVE Pu FISSION RATES IN SLIGHTLY ENRICHED URANIUM–WATER LATTICES. J. J. Volpe and D. Klein (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 10: 401-2(Aug. 1961). (WAPD-T-1352)

The relative fission activation integrals of Pu^{239}, Pu^{240}, and Pu^{241} are measured. Foils of these isotopes are exposed to the neutron flux of the TRX reactor, and the fission activation values are found from the relative fission product activities on the foils. (T.F.H.)

28541 HALF-LIFE OF SODIUM-24. Edward T. Józefowicz (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 379-80(1961). (In English)

The Na^{24} half life is found by liquid scintillation techniques to be 15.05 ± 0.03 hr. Comparison of this value with those found by other methods yields a most probable value of 15.02 ± 0.04 hr. (T.F.H.)

28542 EFFECTIVE NEUTRON ACTIVATION CROSS-SECTIONS OF SOME CHLORINE AND SULPHUR REACTIONS IN NRX. R. W. Durham and F. Girardi (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuovo cimento (10), 19: Suppl. No. 1, 4-17(1961). (CRDC-905). (In English)

Reaction rates are measured in the lattice and reflector of NRX for those neutron activation reactions of chlorine and sulfur that lead to the production Cl^{38}, P^{32}, and S^{35}. The effective cross sections of these reactions for reactor neutrons are calculated from cobalt monitors enclosed with the irradiated samples. (auth)

28543 HYPERFINE SPECTRUM OF CHROMIUM 53 IN Al_2O_3. R. W. Terhune (Ford Motor Co., Dearborn, Mich.), J. Lambe, C. Kikuchi, and J. Baker. Phys. Rev., 123: 1265-8(Aug. 15, 1961).

Electron nuclear double-resonance techniques were used to observe the hyperfine spectrum of Cr^{53} in Al_2O_3. Through analysis of the spectrum at zero degrees a positive value of 48.5 ± 0.1 Mc/sec was obtained for the hyperfine coupling constant and −0.85 ± 0.04 Mc/sec for the quadrupole coupling constant. From this a value of −0.03 barn was deduced for the quadrupole moment of Cr^{53}. (auth)

28544 HIGH-RESOLUTION MEASUREMENTS OF THE $O^{16}(p,\alpha)N^{13}$ EXCITATION FUNCTION. H. A. Hill, E. L. Haase, and D. B. Knudsen (Princeton Univ., N. J.). Phys. Rev., 123: 1301-4(Aug. 15, 1961). (PUC-1961-26)

The $O^{16}(p,\alpha)N^{13}$ activation cross section was measured from 12 to 18 Mev with an energy resolution of 30 kev. The results are essentially the same as obtained by Whitehead and Foster and Rouse, using poorer resolution except for one very narrow resonance. As the proton energy increases through this resonance, the cross section first rises 7% to a maximum, then drops 33% to a minimum, and finally rises 6%. The peak and valley have a width at half-maximum of 30 kev and the peak and valley are separated by 60 kev. The proton energy at halfway down the drop was determined, using the limp-wire technique, to be 14.600 ± 0.020 Mev. This resonance is well suited for calibration purposes. A qualitative interpretation of the results is made using the "cluster model." (auth)

28545 $O^{16}(p,\alpha)N^{13}$ ANGULAR DISTRIBUTIONS AT 13.5-18.1 MEV. Donald R. Maxson (Princeton Univ., N. J.). Phys. Rev., 123: 1304-9(Aug. 15, 1961). (PUC-1961-Z7)

Angular distributions of alpha particles from the $O^{16}(p,\alpha)N^{13}$ ground-state reaction were measured with an ionization chamber at 10 bombarding energies from 13.5 to 18.1 Mev. The angular distributions are oscillatory but not of the form predicted by the plane wave pickup or knockon theories, and the variation with energy is more pronounced than would be expected for a simple direct reaction. The excitation curve has a minimum at $E_p \simeq 16.5$ Mev, and the angular distributions are markedly different above and below that energy. The $O^{16}(p,\alpha)N^{13*}$ (2.4 Mev) reaction is also strongly energy dependent, and the $O^{16}(p,p)O^{16}$ elastic scattering cross section is quite energy sensitive at large angles. The energy dependence of the scattering cross section at 125° appears to be correlated with the $O^{16}(p,\alpha)N^{13}$ excitation function. (auth)

28546 MEASUREMENT OF THE DEUTERON BINDING ENERGY USING A BENT-CRYSTAL SPECTROGRAPH. A. Halim Kazi, Norman C. Rasmussen, and Hans Mark (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 123: 1310-15(Aug. 15, 1961).

The deuteron binding energy has been determined by measuring the neutron-proton capture gamma-ray energy. This energy has been measured directly, relative to annihilation radiation, with the help of a 6-m radius bent-crystal spectrograph. The spectrograph is of the Cauchois type, in which a collimated but extended gamma-ray beam is incident on the convex side of an elastically bent quartz crystal, is diffracted, and is focused onto a focal circle defined by the radius of curvature of the crystal. The neutron-proton-capture gamma rays are produced by placing a polyethylene sample in the through port of the Massachusetts Institute of Technology research reactor. The (310) planes of quartz are used for diffraction, and the gamma-ray lines are recorded on glass mounted 600-μ-thick Ilford G-5 emulsions. The value of B(D) obtained is 2225.5 ± 1.5 kev, where the error is the standard deviation. This is the most precise direct measurement reported to date, and is in agreement with previous work. Using recent mass spectroscopic data, the mass of the neutron is found to be 1.008 984 ± 0.000 002 amu. The efficiency of the spectrograph is low. At 2225 kev, 6000 curie hr is required to record a line; at 511 kev, 1200 curie hr is necessary. The error in B(D) agrees with the estimated precision which varies from about 0.01% at 100 kev to 0.3% at 4000 kev. The latter energy is close to the practical upper energy limit of the instrument. (auth)

28547 $C^{14}(d,n)N^{15}$ REACTION. Ren Chiba (Univ. of Wisconsin, Madison). Phys. Rev., 123: 1316-21(Aug. 15, 1961).

Differential cross sections for ground-state neutrons from the $C^{14}(d,n)N^{15}$ reaction have been measured at E_d = 3.53 Mev and 2.786 Mev by a neutron spectrometer. A stripping peak implying $l_p = 1$ is observed. The excitation function of the ground-state neutrons has been measured from E_d = 1.2 Mev to E_d = 3.53 Mev. A number of resonances were found corresponding to virtual states of N^{16}. The angular distributions of neutrons associated with the 5.28-, 5.31-Mev doublet (unresolved) and 6.33-Mev levels of N^{15} were measured by photographic emulsion technique. A stripping peak characteristic of $l_p = 0$ corresponds to the unresolved doublet, and $l_p = 1$ to the 6.33-Mev state. The excitation function for all neutrons from $C^{14}(d,n)N^{15}$ was measured both by "slow" and "fast" neutron counters. Several possible slow-neutron thresholds were found corresponding to excited states of N^{15}. The sensitivity of the slow-neutron threshold technique was checked by the $O^{16}(d,n)F^{17}$. Accurate values of these thresholds are reported. (auth)

28548 NEUTRONS AND GAMMA RAYS FROM THE BOMBARDMENT OF O^{16} BY He^3. K. L. Dunning and J. W. Butler (U. S. Naval Research Lab., Washington, D. C.). Phys. Rev., 123: 1321-5(Aug. 15, 1961).

The threshold energy for the $O^{16}(He^3,n)Ne^{18}$ reaction has been measured. The value obtained, 3.811 ± 0.015 Mev, determines the mass of Ne^{18} to be 18.011446 ± 0.000014 amu (O^{16} standard, 1960 mass tables). The slow-fast ratio method for the observation of neutron thresholds was employed at bombarding energies from the ground-state threshold to 5.6 Mev, corresponding to a region of excitation in the residual nucleus from zero to 1.5 Mev. No excited states in Ne^{18} were identified. The bombardment of O^{16} by He^3 also produced the reactions $O^{16}(He^3,p)F^{18}$ and $O^{16}(He^3,\alpha)O^{15}$. Energy spectra were obtained by means of a scintillation spectrometer for gamma rays resulting from certain transitions in F^{18} and O^{15}. For 4.5-Mev He^3 particles impinging on a 1-Mev thick target of TiO_2, gamma rays of the following energies were observed and attributed to F^{18}: 0.652 ± 0.007, 0.939 ± 0.005, 1.041 ± 0.005, 1.17 ± 0.01, 1.61 ± 0.02, 1.68 ± 0.02, 2.09 ± 0.01, 2.51 ± 0.01, 2.65 ± 0.05, 3.06 ± 0.05, 3.35 ± 0.10?, and 3.84 ± 0.10 Mev. The following gamma rays were also observed and attributed to O^{15}: 5.25 ± 0.05, 6.22 ± 0.10, and 6.87 ± 0.10 Mev. (auth)

28549 CONFIGURATION MIXING AND THE EFFECTS OF DISTRIBUTED NUCLEAR MAGNETIZATION OF HYPERFINE STRUCTURE IN ODD-A NUCLEI. H. H. Stroke (Massachusetts Inst. of Tech., Cambridge), R. J. Blin-Stoyle, and V. Jaccarino. Phys. Rev., 123: 1326-48 (Aug. 15, 1961).

The theory of Blin-Stoyle and of Arima and Horie, in which the deviations of the nuclear magnetic moments from the single-particle model Schmidt limits are ascribed to configuration mixing, is used as a model to account quantitatively for the effects of the distribution of nuclear magnetization on hyperfine structure (Bohr-Weisskopf effect). A diffuse nuclear charge distribution, as approximated by the trapezoidal Hofstadter model, is used to calculate the required radial electron wave functions. A table of single-particle matrix elements of R^2 and R^4 in a Saxon-Woods type of potential well is included. Explicit formulas are derived to permit comparison with experiment. For all of the available data satisfactory agreement is found. The possibility of using hyperfine structure measurements

sensitive to the distribution of nuclear magnetization in a semiphenomenological treatment in order to obtain information on nuclear configurations is indicated. (auth)

28550 NEW HAFNIUM ISOTOPE, Hf^{182}. J. Wing, B. A. Swartz, and J. R. Huizenga (Argonne National Lab., Ill.). Phys. Rev., 123: 1354-5(Aug. 15, 1961).

A new isotope of hafnium, Hf^{182}, has been produced by double neutron capture in Hf^{180} in the intense neutron flux of the materials testing reactor (MTR). Mass spectrometric analysis of the irradiated hafnium gave a Hf^{182}/Hf^{180} atom ratio of 0.00147 ± 0.00001. The new isotope decays with a half life of $(9 \pm 2) \times 10^6$ years by β^- emission predominantly to a 271-kev level in Ta^{182}. The number of 271-kev gamma rays per β^- disintegration is 0.84 ± 0.10. The log ft for the beta transition to the Ta^{182} ground state is >15 indicating that this transition is at least third forbidden. The neutron capture cross section of Hf^{181} is 40^{+40}_{-20} barns. (auth)

28551 EVIDENCE FOR AN ISOMERIC STATE OF Y^{90}. W. L. Alford, D. R. Koehler, and C. E. Mandeville (Army Rocket and Guided Missile Agency, Redstone Arsenal, Ala.). Phys. Rev., 123: 1365-8(Aug. 15, 1961).

The recently reported activity induced by neutron bombardment of niobium has been produced by 14-Mev neutrons and by neutrons of energy less than 6 Mev, on both niobium and zirconium. In each case, chemical separation showed the activity to be due to an isotope of yttrium. Two coincident gamma rays having energies of 0.200 and 0.485 Mev and a half-life of 3.1 ± 0.1 hr were observed; these observations were in agreement with earlier results. The activity appears very similar to that which has been previously attributed to the decay of Y^{92}. However, threshold considerations and the failure to observe by means of a thin-window Geiger counter any beta emission associated with this gamma activity, point to an isomeric state of Y^{90}. Experiments with separated isotopes of Zr^{90} and Zr^{92} support this assignment. (auth)

28552 SPECTROSCOPY OF GAMMA RADIATION FROM Nd^{144}, Sr^{88}, AND Pb^{207}. J. E. Monahan, S. Raboy, and C. C. Trail (Argonne National Lab., Ill.). Phys. Rev., 123: 1373-81(Aug. 15, 1961).

The energies of the cascade gamma rays in Nd^{144} are found to be 1487.0 ± 1.1 kev and 696.7 ± 0.6 kev and the measured energy of the crossover transition is 2186.0 ± 2.2 kev. The agreement of these results is used to justify the claim of 0.1% accuracy for the scintillation spectrometer with anticoincidence annulus for the measurement of gamma-ray energies in the interval from 0.5 Mev to roughly 3.0 Mev. An energy of 570.8 ± 0.5 kev is obtained for the low-energy radiation from Pb^{207} and energies of 1836.2 ± 1.7 kev and 898.7 ± 0.8 kev are reported for two Sr^{88} gamma rays. Also measurements are given for the relative intensities of the 2.18-Mev, 1.48-Mev, and 0.696-Mev gamma rays of Nd^{144}, the relative intensities of the 1.8-Mev and 0.898-Mev transitions in Sr^{88}, and the relative intensities of the 1.06-Mev and 0.57-Mev transitions in Pb^{207}. (auth)

28553 PARITY CONSERVATION IN NUCLEAR REACTIONS: SEARCH FOR α DECAY OF THE 8.88-MEV STATE IN O^{16}. R. E. Segel, J. W. Olness, and E. L. Sprenkel (Aeronautical Research Lab., Dayton, Ohio). Phys. Rev., 123: 1382-5(Aug. 15, 1961).

A search has been carried out for the parity-nonconserving α decay of the 8.88-Mev (2^-) state in O^{16} by examining the alpha-particle spectrum following N^{16} β decay. An upper limit of $(\Gamma_\alpha/\Gamma_\gamma) < 2 \times 10^{-6}$ was determined which is shown to lead to the estimate that $F^2 \lesssim 2 \times 10^{-12}$. The alpha-particle group corresponding to disintegration of the broad 9.58-Mev (1^-) state was observed and the log ft for the β decay to this state found to be 6.8 ± 0.1, the slow transition rate being in accord with a shell-model prediction that the 9.58-Mev state is due to a three-nucleon excitation. The shape of the alpha spectrum was fitted with a Breit-Wigner analysis. (auth)

28554 MEAN LIFE OF THE 1.61-MEV LEVEL OF Mg^{25}. V. K. Rasmussen, F. R. Metzger, and C. P. Swann (Franklin Inst., Swarthmore, Penna.). Phys. Rev., 123: 1386-92(Aug. 15, 1961).

Nuclear resonance fluorescence techniques have been used to measure the mean life of the 1.61-Mev level of Mg^{25} and the 1.83-Mev level of Mg^{26}. The exciting γ radiation was obtained by bombarding metallic Mg^{25} and Mg^{26} targets with 4.0- and 4.4-Mev protons. For the Mg^{25} level, assumed to be $7/2^+$, the self-absorption of the resonance radiation gives $\tau = (2.5^{+0.6}_{-0.4}) \times 10^{-14}$ sec. The angular distribution for the resonance scattering was found to be $1 + (0.42 \pm 0.03) P_2(\cos\theta) + (0.03 \pm 0.003) P_4(\cos\theta)$, where the errors given are statistical only. For other reasons it is believed that the correct coefficient of the P_4 term is approximately zero. For the Mg^{26} level, the apparent resonance scattering cross section combined with some previous estimates of slowing-down times for the excited nuclei gives $\tau = (7 \pm 3) \times 10^{-13}$ sec. Further evidence as to the collective nature of these nuclei and of Al^{27} is discussed. Support is given to the suggestion of the Chalk River group that the 1.61-Mev Mg^{25} and the 2.21-Mev Al^{27} levels are the $7/2^+$ second members of $K = 5/2^+$ rotational bands based on the ground states. For the Mg^{25} level, spin and parity $7/2^+$ is required to obtain agreement between the quadrupole transition probability from these measurements and that found by Coulomb excitation. (auth)

28555 FORMATION OF N^{13} IN HIGH-ENERGY NUCLEAR REACTIONS. I. Dostrovsky (Weizmann Inst. of Science, Rehovoth, Israel and Brookhaven National Lab., Upton, N. Y.), Z. Fraenkel, and J. Hudis. Phys. Rev., 123: 1452-8(Aug. 15, 1961). (BNL-5376)

Experimental cross sections are reported for the formation of N^{13} in the bombardment of Zn, In, Pb, and U with protons of 1.0, 1.9, and 2.9 Bev energy. These values are compared with theoretical N^{13} emission cross sections for protons energies of 0.84 and 1.84 Bev. The calculations are based on the evaporation model. The previously described Monte Carlo procedure was modified in order to obtain better statistical accuracy for the calculated N^{13} cross sections. Previously computed emission cross sections for He^6, Li^8, and Be^7 were also recomputed using the modified Monte Carlo procedure. The cross sections were computed for three different formulations of the interaction radius. Good fit with the experimental He^6, Li^8, and Be^7 cross sections is obtained when the smaller values for the interaction radius are used. However, the fit with the experimental N^{13} values is not good enough to exclude processes other than evaporation as contributing to the experimentally observed cross sections. (auth)

28556 PHOTOELECTRON SCINTILLATION SPECTROMETER AND THE CONVERSION COEFFICIENT OF THE 279 Kev. TRANSITIONS IN Tl^{203}. B. N. Subba Rao (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sec. A, 53: 244-51(May 1961). (In English)

A spectrometer is designed for measuring conversion coefficients, without requiring a knowledge of the source strength, source-detector geometry, detection efficiency, energy-dependent angular distribution effects, or multiple scattering effects. The spectrometer combines photoelec-

tron and organic scintillation methods. Transitions in Ba^{137} and Tl^{203} are studied as examples. (T.F.H.)

28557 A STUDY OF THE (^{3}He, d) REACTIONS LEADING TO ^{11}C AND ^{12}C. S. Hinds and R. Middleton (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 78: 81-91(July 1, 1961).

The reactions $B^{10}(He^3, d)C^{11}$ and $B^{11}(He, d)C^{12}$ were studied, using magnetic analysis, at a bombarding energy of 9.84 Mev. A new level in C^{11} at 6.345 ± 0.010 Mev excitation was observed. Deuteron angular distributions leading to the ground and first five excited states of C^{11} were measured, and an attempt has been made to fit these with stripping curves. Absolute proton reduced widths for the C^{11} levels were extracted. Using the $B^{11}(He^3, d)$ reaction, the energy levels of C^{12} between 9 and 15 Mev were studied. Natural widths of levels at 10.84, 11.82 and 13.38 Mev were measured to be 320, 300, and 700 kev, respectively. Stripping analyses of the deuteron angular distributions yielded l-values of 2, 0, 0, and 1 respectively for the states of C^{12} at 9.63, 10.84, 11.82, and 12.70 Mev. Absolute proton reduced widths and also α-particle reduced widths, from the measured total widths, were extracted for some levels of C^{12}. (auth)

28558 NUCLEAR ALINEMENT OF COBALT AND THE DECAY OF COBALT-55. C. J. S. Chapman, J. M. Gregory, R. W. Hill, and M. W. Johns (Univ. of Oxford). Proc. Roy. Soc. (London), 262: 541-54(Aug. 8, 1961).

Cobalt-55 was aligned in a crystal of nickel zinc fluosilicate which was magnetically cooled to 0.004°K, and the anisotropy of the 0.935 and 1.41 Mev radiations was studied as a function of temperature. On the assumption that the spin of Co^{55} is $^7/_2$, the spins of the 0, 0.935, and 1.41 Mev levels in Fe^{55} are $^3/_2$, $^5/_2$, and $^7/_2$ respectively with presumably odd parity; the 0.935 Mev γ ray is a dipole-quadrupole mixture with $\delta = +0.37 \pm 0.04$. The magnetic moment of Co^{55} is 4.3 ± 0.3 nm, and the Fermi admixture in the β transition to the 1.41 Mev level of Fe^{55} is less than 10%. The crystals used consisted of an inactive core on to which a layer several millimeters thick and containing the cobalt activity (Co^{55}, Co^{56}, Co^{58}, or Co^{60}), was grown. Data concerning the effect of the nickel concentration in the active layer on the cooling properties of such crystals are presented. The rapidity and ease with which these crystals may be grown should make the technique applicable to isotopes with half lives as short as 10 hr. New data on the Co^{58} alignment indicate that a Fermi admixture of 1 ± 1% is associated with the β transition. (auth)

28559 A SHELL MODEL CALCULATION FOR SCATTERING OF ELECTRONS BY Be^9. Y. R. Waghmare and S. P. Pandya (Physical Research Lab., Ahmedabad, India). Progr. Theoret. Phys. (Kyoto), 25: 822-6(May 1961). (In English)

Elastic and inelastic scattering of 190-Mev electrons by ground and 2.43-Mev states of Be^9 is computed by using an intermediate coupling shell model. The discrepancy between the calculated and the observed inelastic cross sections reported earlier is now removed by taking the correct spin value $J = 5/2^-$ for the 2.43-Mev state. It is shown that a good fit to the observed data requires that different radial extension parameters be chosen for the s- and the p-shell nucleons. The best values obtained are $a_0 = 1.23$ f for the s-shell and 2.0 f for the p-shell. (auth)

28560 INTERACTION BETWEEN ALPHA PARTICLES. Ichirô Shimodaya, Ryozo Tamagaki, and Hajime Tanaka (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 25: 853-5(May 1961). (In English)

By applying the pion-theoretical potentials recently verified in two-nucleon problems, alpha particle interactions were investigated from the viewpoint of the cluster model, without taking account of the polarization effects of the alpha particles. All the features essential to the alpha interactions can be reproduced by pion-theoretical potentials without polarizing alpha clusters. Thus there is strong support for the cluster model. (L.N.N.)

28561 THE EFFECT OF EXCHANGE AND CORRELATION ON BINDING ENERGY OF COMPRESSED ATOMS. M. P. Kawatra (Univ. of Delhi). Progr. Theoret. Phys. (Kyoto), 25: 888-94(June 1961). (In English)

In the binding energy formula the effect of exchange was taken by making use of the Thomas-Fermi-Dirac function. Correlation was incorporated as a perturbation and the effect of finite boundary was taken as given by Scott. The agreement between the calculated values and the experimentally observed ones is much better than provided by Scott. (auth)

28562 INTERACTIONS IN NUCLEON CORE. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 25: 1006-16(June 1961). (In English)

It is pointed out that the K-N interaction rather than the π-N interaction plays the important role in the phenomena within the nucleon core. The processes of pion-nucleon scattering through the s-wave pion-pion interaction are classified into two parts, that is, the processes in the nucleon core and those in the neighborhood of the pion cloud. The contributions from the former to pion-nucleon scattering are estimated and are compared with those from the processes through the mechanism via the $KK\pi\pi$-interaction which may be regarded as one of the phenomena in the nucleon core. Moreover, some discussion about the anomalous magnetic moments of nucleons is made. (auth)

28563 NOTE ON THE PAIRING CORRELATION IN NUCLEAR MATTER. Toshio Marumori (Kyoto Univ.), Toshiyuki Murota, Shuji Takagi, Hajime Tanaka, and Masaru Yasuno. Progr. Theoret. Phys. (Kyoto), 25: 1035-42(June 1961). (In English)

A difficulty in literally applying the Bardeen-Cooper-Shrieffer (BCS)-Bogolyubov formalism to the nuclear system with singular interaction is pointed out. A prescription to overcome this difficulty is proposed. According to this method, it is possible to consistently join the BCS-Bogolyubov formalism with the "reaction matrix" formalism in a unified manner. The results obtained verify the validity of the basic conjecture underlying Cooper-Mills-Sessler's procedure. (auth)

28564 REMARKS ON THE MASS FORMULA IN THE SAKATA MODEL. Ken-ichi Matumoto (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 1047-9(June 1961). (In English)

A proposed mass formula for baryons and mesons is discussed. In the formula, $M = m_N(n_N + n_{\bar{N}}) + m_\Lambda(n_\Lambda + n_{\bar{\Lambda}}) - V_{N\bar{N}}n_{N\bar{N}} - V_{NN}(n_{NN} + n_{\bar{N}\bar{N}}) - V_{N\Lambda}(n_{N\bar{\Lambda}} + n_{\Lambda\bar{N}}) - V_{N\Lambda}(n_{N\Lambda} + n_{\bar{N}\bar{\Lambda}}) - V_{\Lambda\bar{\Lambda}}n_{\Lambda\bar{\Lambda}} - V_{\Lambda\Lambda}(n_{\Lambda\Lambda} + n_{\bar{\Lambda}\bar{\Lambda}})$, where $n_N, \ldots n_\Lambda, n_{N\bar{N}}, \ldots, n_{\Lambda\Lambda}$ are the number of N,..., V, $N\bar{N}$ pair,..., $\Lambda\Lambda$ pair in the composite particle; it is assumed that $V_{N\bar{N}} = -V_{NN}$, $N_{N\bar{\Lambda}} = -V_{N\Lambda}$, $V_{N\bar{\Lambda}} = V_{N\bar{N}} - \Delta V$ with $\Delta V/V_{N\bar{N}} \simeq 0.10$, $V_{\Lambda\Lambda} = V_{N\Lambda} - \Delta V'$ with $\Delta V'/V_{N\Lambda} \simeq 0.14$, and $V_{N\bar{N}} = 2m_N - m_\pi(2m_N)$. By releasing these restrictions, the coefficients to fit with the observed mass values are determined. These fit with the previous ones in very small errors, suggesting some significant physical background and the relations $M \approx m(n_B - n_{\bar{B}})^2 + \Delta m\{2(n_\Lambda + n_{\bar{\Lambda}}) - (n_B - n_{\bar{B}})(n_\Lambda - n_{\bar{\Lambda}})\}$ + small term, where $n_B = n_N + n_\Lambda$, $m \simeq m_N$, and $\Delta m \simeq m_\Lambda - m_N$. It is suggested that the masses of the composite particles (for instance, the vanishing π-meson mass) are due to the same origin of the mass of the fundamental baryon. (L.N.N.)

28565 VIBRATIONS OF SPHERICAL NUCLEI. Taro Tamura and Takeshi Udagawa (Tokyo Univ. of Education). Progr. Theoret. Phys. Kyoto), 25: 1051-3(June 1961). (In English)

The dispersion relation is derived, taking into consideration proton polarization inducement of neutron polarization and vice versa. It is assumed that there exists a long-range correlation between protons and neutrons, of essentially the same type as was assumed among protons and among neutrons. (L.N.N.)

28566 THE γ-ENERGY RELEASE FROM U^{235} THERMAL NEUTRON FISSION PRODUCTS DURING PERIODIC REACTOR OPERATIONS. T. Roshesku (Inst. of Atomic Energy, Rumania). Rev. phys., Acad. rep. populaire Roumaine, 5: 393-404(1960). (In Russian)

The gamma energy and spectrum from fission products are calculated for 6- and 12-hour reactor operations and cooling periods of 24 hours or more. The curves are correlated with data presented by I. F. Perkins et al. (Nuclear Science and Engineering, 3, 729, 1958). (R.V.J.)

28567 RESONANCES IN AND GAMMA RAYS FROM $Mg^{25}(p,\gamma)Al^{26}$. Karl-Edvard Nystén. Soc. Sci. Fennica, Commentationes Phys.-Math., 24: No. 9, 1-34(1960). (In English)

The reaction $Mg^{25}(p,\gamma)Al^{26}$ is investigated in the proton energy (E_p) range E_p = 850 to 1400 kev, using a Van de Graaff accelerator and a scintillation detector. A resonance at E_p = 970 kev is found, its intensity being 10% of that of the 956 kev resonance. Evidence is also found for another resonance at E_p = 928 kev, although this resonance can not be separated completely from the nearby 932 kev resonance. Gamma spectra are measured at the 956 and 990 kev resonances. The following new gamma rays are found: 7.23, and 6.81 Mev at E_p = 956 kev; and 7.25 and 6.87 Mev at E_p = 990 kev. These γ rays represent transitions from the resonance levels to the ground state and to the second excited level. The relative intensities are estimated. Different spin and parity assignments are discussed in terms of level schemes. It seems likely that both resonance levels have j = 3, T = 1, and odd parity. (auth)

28568 NEUTRON YIELD FOR THE REACTION BETWEEN TRITONS AND FLUORINE AND ALUMINUM NUCLEI. A. K. Valter, P. I. Vatset, L. Ya Kolesnikov, S. G. Tonopetyan, K. K. Chernyavskii, and A. I. Shpetnyi (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1237-43(May 1961). (In Russian)

The neutron yield from the $F^{19}(t,n)$ and $Al^{27}(t,n)$ reactions was studied for triton energies up to 2.4 Mev. The dependence of the differential cross section for neutron emission at an angle of 0^0 on the triton energy is derived. The position of a set of excited levels in the intermediate nucleus Ne^{22} could be determined on the basis of the resonance course of the differential cross section for the F(t,n) reaction. The symmetry of the neutron angular distribution in the cms relative to 90° at five triton energies indicates that up to 2.1 Mev the $F^{19}(t,n)$ reaction proceeds mainly via the formation of an intermediate nucleus. The total cross sections of the $F^{19}(t,n)$ reaction were determined for a number of energies. (auth)

28569 INTERACTION OF 14.1 Mev NEUTRONS WITH Be^9. S. A. Myachkova and V. P. Perelygin (Lebedev Inst. of Physics, [Moscow]). Zhur. Eksptl'. i Teoret. Fiz., 40: 1244-9(May 1961). (In Russian)

The interaction between 14.1 Mev neutrons and Be^9 was investigated by means of photographic emulsions. The energy and angular distributions of neutrons and α particles produced in the (n,2n) reaction were measured. The data obtained indicate that the reaction essentially involves a 2.9 Mev excited state in the Be^8 nucleus (cross section 0.19 ± 0.06 b) and 2.43 Mev excited level in Be^9. The cross section for excitation of the Be^9 (2.43 Mev) nucleus and for formation of the ground state in the Be^8 nucleus is 0.2 ± 0.1 b. Direct interactions also yield an appreciable contribution to the (n,2n) reaction. The total cross section for the reaction is 0.54 ± 0.07 b. (auth)

28570 ANISOTROPY IN THE FISSION OF BISMUTH AND URANIUM IRRADIATED BY 660 Mev PROTONS. A. I. Obukhov and N. A. Perfilov (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1250-2 (May 1961). (In Russian)

The angular distribution of fission fragments from bismuth and uranium irradiated by 660 Mev protons was studied with the aid of nuclear emulsions. The perpendicular anisotropy coefficients were found to be 0.02 ± 0.06 and 0.04 ± 0.07 for bismuth and uranium, respectively. (auth)

28571 INELASTIC SCATTERING OF PROTONS BY Ne^{20} NUCLEI. P. V. Sorokin, A. I. Popov, V. E. Storizhko, and A. Ya. Taranov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1253-6(May 1961). (In Russian)

The absolute cross section for the reaction Ne^{20} $(p,p'\gamma)$ and the angular distributions of p' and γ corresponding to the first excited state of Ne^{20} is measured at the resonance energies 2.15 Mev and 2.72 Mev. The partial widths and reduced widths are determined for the 4.5 and 5.05 Mev levels of the Na^{21} nucleus. Inelastic scattering of 2.72 Mev protons is shown to be related to a single level in the Na^{21} nucleus with a spin and parity of $3/2^+$. (auth)

28572 NEUTRONS FROM THE $C^{12}(t,n)$ REACTION. P. I. Vatset, L. Ya. Kolesnikov, and S. G. Tonapetyan (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1257-60(May 1961). (In Russian)

The neutron yield at an angle of 0^0 from the C^{12} (t,n) reaction is investigated for triton energies between 0.35 and 2.4 Mev. Seven resonances were observed corresponding to excited state of the N^{15} nucleus at: 15.887, 15.955, 16.066, 16.206, 16.326, 16.430, 16.582, 16.67, and 16.77 Mev. The neutron angular distributions are measured for five different triton bombarding energies. For triton energies exceeding 1 Mev the angular distributions are anisotropic; above 1.5 Mev triton energies neutrons are emitted predominantly in the backward direction. The total cross section for the reaction was determined from the angular distributions and found to be 4.8 ± 0.2 mb for E_t = 0.652 Mev and increases up to 298.6 ± 19.7 mb at E_t = 2.017 Mev. (auth)

28573 SPONTANEOUS FISSION OF Am^{241}. V. A. Druin, V. L. Mikheev, and N. K. Skobelev (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1261-2(May 1961). (In Russian)

A gas scintillation counter filled with xenon was used to measure the spontaneous fission period of Am^{241}. A value of $(2.3 \pm 0.8) \times 10^{14}$ years was found in contrast to the previously accepted value 1.4×10^{13}. (auth)

28574 PRODUCTION OF TRITIUM IN LEAD AND ALUMINIUM BY HIGH ENERGY PROTONS, DEUTERONS AND α-PARTICLES. V. V. Kuznetsov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1263-9(May 1961). (In Russian)

Experimental data are presented on the production of tritium in lead and aluminium by 70 to 390 Mev deuterons

and 140 to 750 Mev α particles and also in zinc and cadmium by 750 Mev α particles. The tritium yields from aluminium and lead targets of various thicknesses bombarded by 660 Mev protons are also given. (auth)

28575 DEVIATIONS OF THE CROSS SECTIONS FOR SLOW NEUTRON REACTIONS ON LIGHT NUCLEI FROM THE 1/v LAW. A. A. Bergman and F. L. Shapiro (Lebedev Inst. of Physics, [Moscow]). Zhur. Eksptl'. i Teoret. Fiz., 40: 1270-81(May 1961). (In Russian)

The energy dependence of the cross section ratios for the reactions $Li^6(n,\alpha)$, $B^{10}(n,\alpha)$ and $He^3(n,p)$ are measured for neutron energies E < 30 kev. A correction to the 1/v law was found which can be expressed as a constant term to the reaction cross section and is respectively -0.03 ± 0.01, -0.40 ± 0.03, and -1.1 ± 0.2 b for Li^6, B^{10}, and He^3. Available data on the Li^7 (p,n) reaction indicate that the constant term in the Be^7 cross section is -61 ± 7 b. The results obtained are in good agreement with the theoretical predictions. They show that capture of slow neutrons by the He^3 nucleus proceeds along the channel with 0^+ spin and parity and confirm the assumption that capture of slow neutrons by the B^{10} and Be^7 nuclei proceeds along channels with spins and parities of $^7/_2{}^+$ and 2^- respectively. (auth)

28576 NUCLEAR RESONANCE OF Sn^{119} IN METALLIC TIN. Yu. S. Karimov and I. F. Shchegolev (Inst. of Problems in Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1289-92(May 1961). (In Russian)

The dependence of the second moment of the absorption line of Sn^{119} on the external magnetic field strength was measured between 900 and 5800 Gauss in metallic tin. A value of $\delta = 1.0 \times 10^{-3}$ was obtained for the Knight shift anisotropy. The indirect exchange coupling constant between neighboring nuclei in the metal was determined: A = 2.5 kc/sec. (auth)

28577 SPONTANEOUS FISSION PERIODS OF Np^{237}, Pu^{238}, AND Pu^{242}. V. A. Druin, V. P. Perelygin, and G. I. Khlebnikov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1296-8(May 1961). (In Russian)

An attempt is made to determine the true spontaneous fission period for Np^{237} by employing nuclear emulsions. Prior to development the photographic plates were treated with potassium ferrocyanide to remove background tracks. Reliability of the method was checked by measuring the spontaneous fission periods of Pu^{238} and Pu^{242} which were independently determined with a proportional counter. The plutonium results obtained by the various methods were found to be the same and agree with other available data. Only three fragment tracks were detected in Np^{237} photographic measurements. Thus only a lower limit of 10^{18} years for the half life can be derived as compared with the usually accepted value of 4×10^{16} years. (auth)

28578 ANGULAR CORRELATIONS DURING INELASTIC SCATTERING OF HIGH ENERGY NUCLEONS. G. L. Lysotskii (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1399-1403(May 1961). (In Russian)

Angular correlations in inelastic scattering of high energy nucleons on nuclei with zero spin and zero isotopic spin are examined. The calculation is carried out in the impulse approximation at small angles. It is shown that the correlation function and its dependence on the nucleon scattering angle is determined by the parity and isotopic spin of the excited level. (auth)

28579 RELATIVE PROBABILITIES OF α-DECAY TO ROTATIONAL LEVELS OF NONAXIAL EVEN-EVEN NUCLEI. V. S. Rostovskii (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1411-17(May 1961). (In Russian)

The wave function for a system consisting of a nucleus and an α particle is derived under the assumption that it is constant on the surface of a nonaxial nucleus. The relative probabilities of α decay to the levels of ground and "anomalous" rotational bands of the daughter nucleus are also determined. The results are compared with experiments. (auth)

28580 ROTATIONAL STATES OF ODD NUCLEI WITH SMALL NONAXIALITY. A. S. Davydov and R. A. Sardaryan (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1429-33(May 1961). (In Russian)

The dependence of the energy spectrum of the excited states of odd nuclei with a ground state spin $^5/_2$ on the rotational energy ratio to the coupling energy between the external nucleon and nonspherical part of the core potential is computed. (auth)

28581 ON NEUTRON TRANSFER IN NUCLEAR COLLISIONS. T. L. Abelishvili (Inst. of Electronics, Automatization and Telemechanics, Academy of Sciences, Georgian SSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1440-5(May 1961). (In Russian)

Neutron transfer in nuclear collisions is considered in the case where the influence of the Coulomb field is significant. The possibility of compound nucleus formation at energies above the Coulomb barrier is taken into account. The differential cross section reaches a maximum and with the increase of energy shifts toward smaller angles. The angular dependence of the cross section weakly depends on the angular momentum of the state in which the neutron is captured. The calculation is restricted to the case in which the thermal effect of the reaction is small compared with the energy of the colliding nuclei. (auth)

28582 THE PROPERTIES OF SOME STRONGLY DEFORMED NUCLEI. Liu Yüan, N. I. Pyatov, V. G. Solov'ev, I. N. Silin, and V. I. Furman (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1503-10(May 1961). (In Russian)

An improved scheme of single-particle levels of a self-consistent field is employed to investigate some properties of strongly deformed nuclei in the range 150 < A < 190 on the basis of the superfluidity model. Mean values of pair coupling constants are evaluated by comparing the calculated pair energies with experimental data. The density of low energy single-particle energy levels of odd nuclei is calculated and found to agree with the experimental data and to exceed the level density predicted by the Nilsson scheme by approximately two times. Some regularities in the behavior of weakly excited states in even-even nuclei are noted. On the average the errors in the calculations due to conservation of the number of particles do not exceed 6%. (auth)

28583 ENERGY DEPENDENCE OF CROSS SECTIONS NEAR THE "THRESHOLD" FOR UNSTABLE PARTICLE PRODUCTION. A. I. Baz' (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1511-15 (May 1961). (In Russian)

The energy dependence of the cross sections for elastic scattering, X(aa) X, and for the reaction X(ab)Y are determined near the "threshold" for production of an unstable particle Y which decays immediately after its production (Y → c + d). (auth)

28584 POSSIBLE OBSERVATION OF THE He^8 NUCLEUS. O. V. Lozhkin, and A. A. Rimskii-Korsakov (Ra-

dium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 40: 1519-20(May 1961). (In Russian)

Two "unique" T-shaped tracks in emulsions irradiated by 930-Mev and 9-Bev protons are described. The tracks were discovered during investigations of fragmentations. The tracks were discovered due to their unnatural low grain density. (R.V.J.)

28585 TRIPLE FISSION OF URANIUM INDUCED BY FAST NEUTRONS. N. A. Perfilov, Z. I. Soloveva, and R. A. Filov (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 11-12(July 1961). (In Russian)

Triple fission of U^{238} induced by 14 Mev neutrons is investigated. The fission characteristics obtained are compared with triple fission of U^{235} induced by thermal neutrons. (auth)

28586 MEAN ENERGY OF THE Y^{90} β-SPECTRUM. E. I. Biryukov, B. S. Kuznetsov, and N. S. Shimanskaya (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 22-3(July 1961). (In Russian)

The mean energy of the Y^{90} β spectrum was measured calorimetrically and the value 933 ± 18 kev was obtained. (auth)

28587 ANGULAR DISTRIBUTION OF 14 Mev NEUTRONS ELASTICALLY SCATTERED ON CARBON, NITROGEN AND SULPHUR. V. V. Bobyr, L. Ya. Grona, and V. I. Strizhak (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 24-5(July 1961). (In Russian)

The angular distributions of neutrons elastically scattered on C, N, and S nuclei in which the first excited states are excited are measured. The results are consistent with the predictions of the direct interaction model. (auth)

28588 ELASTIC SCATTERING OF 5.45 Mev PROTONS ON ZIRCONIUM NUCLEI. V. Ya. Golovnya, A. P. Klyucharev, and B. A. Shilyaev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 32-4(July 1961). (In Russian)

The angular distributions of 5.45 Mev protons elastically scattered on Zr^{90} and Zr^{91} nuclei were measured by the scintillation technique. It does not seem probable that the great difference in the angular distribution curves can be explained by the difference of the (p,n) threshold for these nuclei which compete with elastic p–p scattering involving capture. (auth)

28589 CHARGE DISTRIBUTIONS OF FRAGMENTS IN NUCLEAR DISINTEGRATIONS. P. A. Gorichev, O. V. Lozhkin, and N. A. Perfilov (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 35-7 (July 1961). (In Russian)

The charge distributions of fragments with Z = 4 – 8 produced in the disintegration of Ag and Br nuclei by 9 Bev protons are investigated. The analysis is carried out for small and large energy transfers to the nucleus, for various directions of emission of the fragments, and for cases involving the emission of two or more fragments in a single disintegration. The fragment charge distributions are found to be practically the same in all indicated cases. A discussion of the data obtained is presented. (auth)

28590 ELASTIC SCATTERING OF 10 TO 15 Mev α-PARTICLES ON GOLD AND ALUMINIUM. M. P. Konstantinova, E. V. Myakinin, A. M. Romanov, and T. V. Tsareva (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 49-51(July 1961). (In Russian)

The angular distribution of α particles elastically scattered on gold and aluminum is investigated. The differential cross sections for scattering on gold satisfy the Rutherford formula for angles between 10 to 140°. A feature of the angular distribution of α particles elastically scattered on aluminum is the presence of maxima and minima. (auth)

28591 SCATTERING OF 1 TO 5 Bev/c μ-MESONS IN LEAD. S. A. Azimov, G. G. Arushanov, Kh. Zainutdinov, R. Karimov, V. S. Masagutov, and M. Kh. Esterlis (Inst. of Physics and Tech., Academy of Sciences, Uzbek SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 56-9(July 1961). (In Russian)

Scattering of 1 to 5 Bev/c μ-mesons in 2 cm thick lead plates located in a cloud chamber was studied. The experimental results are in good agreement with the multiple scattering theory of Cooper and Rainwater in which the finite size of the nucleus is taken into account. (auth)

28592 YIELD OF FAST PHOTONEUTRONS FROM C^{12} AND Al^{27}. V. Presperin and L. A. Kulchitskii (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 60-3(July 1961). (In Russian)

A threshold detector was employed to measure the yield of fast photoneutrons (En ≥ 11 Mev) produced by γ quanta with energies up to 85 Mev on C^{12} and Al^{27} nuclei. The experimental results indicate the predominance of a single-particle mechanism of fast photoneutron production (only one fast neutron being emitted from the nucleus). (auth)

28593 EXCITED LEVELS OF Ne^{22}. A. M. Romanov, E. V. Myakinin, and M. P. Konstantinova (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 64-5(July 1961). (In Russian)

The levels of the Ne^{22} nucleus in the interval from 1 to 9 Mev are determined from the proton spectrum of the $F^{19}(\alpha,p)Ne^{22}$ reaction. (auth)

28594 EXCITATION OF NUCLEAR ROTATIONAL LEVELS IN μ-MESIC ATOM TRANSITIONS. G. E. Belovitskii (Lebedev Inst. of Physics, [Moscow]). Zhur. Eksptl' i Teoret. Fiz., 41: 66-70(July 1961). (In Russian)

The presence of coulomb excitation of nuclear rotational levels in the U^{238} nucleus during μ^- mesic atom transitions is established by aid of the nuclear emulsion technique. The probability of the process is ~0.5 in satisfactory agreement with the theoretically expected value. (auth)

28595 ANGULAR DISTRIBUTION OF 6.8 Mev PROTONS ELASTICALLY SCATTERED ON NICKEL AND ZIRCONIUM ISOTOPES. A. K. Valter, I. I. Zalyubovskii, A. P. Klyucharev, V. A. Lutsik, B. F. Orlenko, M. V. Pasechnik, V. S. Prokopenko, and N. N. Pucherov (Inst. of Physics. Academy of Sciences, Ukrainian SSR and Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 71-4(July 1961). (In Russian)

The angular distribution of 6.8 Mev protons elastically scattered by Ni^{64}, Zr^{90-92}, and Zr^{96} nuclei is investigated. A large difference was found. (auth)

28596 THE CROSS SECTION FOR PRODUCTION OF HYPERNUCLEI IN PHOTOGRAPHIC EMULSIONS BY 9 Bev PROTONS. I. B. Berkovich, A. P. Zhdanov, F. G. Lepekhin, and Z. S. Khokhlova (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 75-7(July 1961). (In Russian)

The cross section for production of hypernuclei in the NIKFI-P photographic emulsion irradiated by 9 Bev protons is found to be $\sigma_{Hf} = (0.2 \pm 0.1)$mb. (auth)

28597 INTERACTION OF 78 Mev π^+-MESONS IN PROPANE. R. G. Salukvadze and D. Neagu (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 78-80(July 1961). (In Russian)

A propane bubble chamber was employed to study the interaction between 78 ± 3 Mev π^+ mesons and hydrogen and carbon. The scattering cross sections in hydrogen and carbon and also the absorption cross section in carbon were also determined. The prongs of stars produced by the absorption of mesons are predominantly directed toward the front hemisphere and this indicates that the mesons suffer quasielastic collisions in the nucleus prior to their absorption. (auth)

28598 μ^--MESON CAPTURE IN CARBON INVOLVING THE FORMATION OF B^{12}. A. O. Vaisenberg (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 109-12(July 1961). (In Russian)

Approximately 500 two-prong stars produced in the capture of μ^- mesons by light photographic emulsion nuclei are examined. The probability for emission of an Auger electron in a capture of this type is of the order of a tenth of a percent. Nine stars of the type $\mu^- + C^{12} \rightarrow B^{12*} + \nu$; $B^{12*} \rightarrow Li^8 + He^4$ were detected. The probability of such a reaction is 2×10^{-3} per capture in a carbon nucleus. It is shown that there should be excited levels in the B^{12} nucleus with an energy ~19–26 Mev from which breakup into Li^8 and He^4 may be possible. (auth)

28599 PRODUCTION OF TRITIUM IN COLLISIONS OF FAST PROTONS WITH HEAVY NUCLEI. S. V. Izmailov and I. I. Pyanov (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 118-26(July 1961). (In Russian)

Probability is calculated of the production of tritium as a result of indirect evaporation when heavy nuclei are bombarded by protons with an energy of ~100 Mev. (auth)

28600 THE SHELL MODEL AND THE SHIFT OF SINGLE-PARTICLE LEVELS IN NUCLEI OF THE "CORE + NUCLEON" TYPE DUE TO ADDITION OF A PAIR OF NUCLEONS. V. E. Asribekov. Zhur. Eksptl'. i Teoret. Fiz., 41: 171-82(July 1916). (In Russian)

The shift of single-particle levels in nuclei of the "core + nucleon" type caused by the addition of a pair of particles (nucleons or holes) of the same type to the nucleus is investigated within the framework of the shell model. The shifts are estimated quantitatively by perturbation theory calculation of the change of the distances between the levels as a result of unequal shifting of the latter when an additional pair is added to the nucleus. Two mechanisms of level shift are examined: 1) the shift is due to a change in the core parameters (isotopic and isotonic shifts) and 2) that due to direct interaction between the pair and odd particle, the core remaining unperturbed (in this case the pair enters the nucleus as a system which is autonomous and independent of the core and in which the particles are paired with respect to the angular momentum J = 0). An estimation of the isotopic and isotonic shifts for a number of typical nuclei indicates that the first mechanism does not correspond to the experiments. On the other hand, a calculation of the relative level shifts based on the second mechanism performed for a large number of nuclei of the "core + nucleon" type for which experimental level schemes are available, lead to results which are in good agreement with the experimental data. It is shown that there is a competition between the closely spaced levels on which the pair is located. (auth)

28601 ON THE RADIATIVE CORRECTIONS TO β-DECAY. B. V. Geshkenbein and V. S. Popov. Zhur. Eksptl'. i Teoret. Fiz., 41: 199-204(July 1961). (In Russian)

The problem of radiative corrections to β decay is discussed. A method for introducing various form factors for the proton and electron (interacting with a photon) is indicated which does not contradict gauge invariance. An estimation is made of the contribution from graphs corresponding to the emission of a virtual photon directly from a four-fermion vertex renormalized by strong coupling. The estimation shows that the contribution from these graphs may significantly change the magnitude of the radiative correction to β decay and remove the discrepancy between the theoretical predictions with conservation of vector current and the experiments. (auth)

28602 ON EXCITATION OF NUCLEI IN HEAVY μ-MESIC ATOMS. D. F. Zaretskii and V. M. Novikov. Zhur. Eksptl'. i Teoret. Fiz., 41: 214-21(July 1961). (In Russian)

The process of electromagnetic excitation of nuclei by muons (nonradiative excitation) during a 2p–1s transition in the mesic atom is considered. The ratio of the probability of emission of a γ quantum by a muon to the probability of nonradiative excitation with subsequent decay of the nucleus via various channels is calculated. (auth)

28603 NONADIABATIC CORRECTIONS TO THE ROTATIONAL SPECTRUM OF ATOMIC NUCLEI. Yu. T. Grin. Zhur. Eksptl'. i Teoret. Fiz., 41: 222-5(July 1961). (In Russian)

The term $BI^2(I + 1)^2$ in the energy of a rotating system of particles was calculated on the basis of a consistent microscopic description in which pair correlation is not taken into account. The value of B thus obtained qualitatively agrees with the experimental value. (auth)

28604 NUCLEON CORRELATIONS IN PHOTONUCLEAR REACTIONS. I. PHOTODISINTEGRATION OF He^4. G. M. Shklyarevskii (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 234-8(July 1961). (In Russian)

Photodisintegration of the He^4 nucleus is examined in a model which takes into account nucleon pair correlations. The experimental data permit one to estimate the pair correlation range r_K^S(S is the spin of the correlated pair). In triplet states $r_K^1 \approx (1.3 \text{ to } 1.4) \times 10^{-13}$ cm. An upper limit $r_K^0 \leq r_K^1/3$ has been obtained for the correlation range in singlet states. (auth)

28605 ON EXCITATION OF NUCLEI BY MUONS IN HEAVY MESIC ATOMS. V. M. Novikov. Zhur. Eksptl'. i Teoret. Fiz., 41: 272-80(July 1961). (In Russian)

The ratio of the width of an arbitrary muon level in a mesic atom (the width being dependent on nonradiative excitation of the nucleus) to the radiative width of this level is computed. The ratio is shown to be slightly dependent on the muon matrix elements. (auth)

28606 β AND γ SPECTRA OF Te^{117}. N. A. Vartanov, Yu. A. Ryukhin, I. P. Selinov, V. L. Chikhladze, and D. E. Khulelidze (Inst. of Physics and Tech., Academy of Sciences, Georgian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 303(July 1961). (In Russian)

The half life of Te^{117}, measured with a scintillation spectrometer and an end-window counter, was 1.1 ± 0.1 hour. The intensity of the 0.71 Mev γ line is about two folds higher than the annihilation emission. Considering the theoretical ratio of positron decay and K-capture probability as ~1, the β^+ transition log $\tau f = 4.3$ and is not forbidden. The coefficient of internal conversion for E_γ = 0.72 Mev is $\alpha_K = 3 \times 10^{-3}$. Correlations with the theoretical magnitude of α_K for the transition Z = 51 indicate the multipole order of transition M1 or E2. (R.V.J.)

28607 ASYMMETRY IN ANGULAR DISTRIBUTION OF NEUTRONS EMITTED IN μ^- MESON CAPTURE IN CALCIUM. V. S. Evseev, V. I. Komarov, V. Z. Kush, V. S.

Roganov, V. A. Chernogorova, and M. M. Shimchak (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 306-7(July 1961). (In Russian)

Measurements of $\tilde{\alpha}$ asymmetry in μ^- absorption in calcium were made using 250 Mev/c pulsed μ^- mesons stopped in a 12 g/cm^2 calcium target in a magnetic field. The preliminary data show $\tilde{\alpha}_{Ca} = -(0.93 \pm 0.33)$. The theoretical and measured magnitudes of $\tilde{\alpha}$ indicate the presence of pseudoscalar interaction in the $\mu^- + A \rightarrow A' + n + \bar{\nu}$ process. The sign of the pseudoscalar and pseudovector constant in the ratio g_p/g_A is positive. The value of $\tilde{\alpha}$ is considerably larger than the theoretical value $\tilde{\alpha} = 0.41$ developed with $g_A/g_v = -1.25$, $g_p/g_A = 8$, and $g_T/g_v = 3.7$. (R.V.J.)

Particle Accelerators

28608 (AFOSR-878) INSTABILITY OF ELECTRONS DRIFTING THROUGH IONS ACROSS A MAGNETIC FIELD. Technical Report No. 251-1. O. Buneman (Stanford Univ., Calif. Electron Devices Lab.). July 20, 1961. Contract AF49(638)-660. 20p.

An attempt was made to show that a drift motion of electrons across ions results in the usual two-stream instability and that the magnetic field, while reducing the growth rate to some extent, is unable to inhibit the instability effectively. It is proposed to let only the electrons drift steadily and allow the ions to be accelerated slowly by the steady electric and magnetic field, their initial velocity being such that it is not maintained since it does not coincide with E/B in the required direction. The unperturbed state, the nature of the instability, the dispersion equation, Appleton-Hartree resonances, the effective ion mass, the least unstable direction of propagation, and build-up time are discussed. (M.C.G.)

28609 (CERN-61-18) INITIAL THOUGHTS FOR A MODIFICATION OF THE CERN 600-MEV PROTON SYNCHRO-CYCLOTRON. Nils Vogt-Nilsen (European Organization for Nuclear Research, Geneva). June 1961. 44p.

A study was made of the possibility of modifying the present CERN 600-Mev synchrocyclotron into a higher intensity device. It was found that redesign of the synchrocyclotron as a constant-frequency machine is the most feasible scheme and that, if the final kinetic energy is lowered to 450 to 500 Mev, the beam intensity should increase from ~1 μa to 0.1 or 1 ma. (D.L.C.)

28610 (CERN-61-19) CERN PROTON SYNCHROTRON MACHINE GROUP, OPERATION AND DEVELOPMENT, QUARTERLY REPORT NO. 4, OCTOBER–DECEMBER 1960. (European Organization for Nuclear Research, Geneva). June 16, 1961. 37p.

The machine component development, measurements, and operation and some of the experiments performed with this machine are described in detail. The p–p total cross section was found to be ~ 40 ± 2 mb over an energy range of 1 to 11 Bev/c. Mass analysis was carried out on long-lived ($\geq 10^{-8}$ sec) charged particles produced in the forward direction by 24-Bev protons striking an internal target of Al or Be. The total cross sections of K_2^0 mesons with C, CH_2, and H were measured at >4.6, >8.8, and >10.9 Bev/c. The antiproton mass relative to the proton mass was determined to be 1.005 ± 0.008. Photon attenuation measurements at 10 to 14 Bev are reported. Emulsion, radiochemical, and bubble chamber experiments are also described. (D.L.C.)

28611 (CTSL-12) PRELIMINARY COST ESTIMATE FOR A 300 GEV CASCADE SYNCHROTRON. M. H. Blewett (California Inst. of Tech., Pasadena. Synchrotron Lab.). Oct. 20, 1960. 11p. Contract AT(11-1)-68.

A cost estimate for a 300 Bev cascade synchrotron is presented. Included are salaries and overhead, general buildings and utilities, linac and booster ring, and main ring. The total cost was estimated to be $125 million. (M.C.G.)

28612 (CTSL-15) A RADIO FREQUENCY SYSTEM FOR A 300 GEV PROTON SYNCHROTRON. Kenneth W. Robinson (California Inst. of Tech., Pasadena. Synchrotron Lab.). Jan. 19, 1961. Contract AT(11-1)-68. 13p.

An investigation was made of a radiofrequency system for a 300-Bev proton synchrotron, using the constant-frequency, phase-shifting method. (auth)

28613 (CTSL-16) BEAM TRANSFER IN THE CASCADE SYNCHROTRON. Robert L. Walker (California Inst. of Tech., Pasadena. Synchrotron Lab.). Jan. 1961. Contract AT(11-1)-68. 28p.

The problems of beam transfer from the booster to the main ring of the cascade synchrotron are discussed. The beam was ejected from the booster by "kicking" the beam through a small angle with a pulsed magnetic field, so that the beam enters a high-field d-c septum magnet located approximately ¼ wavelength of a betatron oscillation later. This high-field bending magnet then bent the beam away from the booster ring magnets and into the beam transport system. (M.C.G.)

28614 (MURA-612) EFFECTS OF RADIAL STRAIGHT SECTIONS FROM A GENERAL POINT OF VIEW. W. N. Wong (Midwestern Universities Research Assn., Madison, Wis.). Feb. 27, 1961. Contract AT(11-1)-384. 13p.

General properties of equilibrium orbits and techniques in the amplitude modulation of the field are discussed in preparation for a formal proof to deny the existence of any radial straight section distribution scheme that will preserve the scaling property of the equilibrium orbits of a certain class of field pattern. (auth)

28615 (MURA-619) SCREENING WITH CURRENT SHEETS. J. Van Bladel (Midwestern Universities Research Assn., Madison, Wis.). May 18, 1961. Contract AT(11-1)-384. 18p.

The establishment of a given magnetic field inside the vacuum chamber of an accelerator and screening the surrounding space from this magnetic field is discussed. The possibility of achieving this with suitably disposed electric current sheets was investigated. (auth)

28616 (MURA-623) THE EFFECT OF CURVATURE ON THE FIELDS IN A CIRCULAR ACCELERATOR. J. Van Bladel (Midwestern Universities Research Assn., Madison, Wis.). June 15, 1961. Contract AT(11-1)-384. 38p.

A comparison was made between the electromagnetic fields in a circular accelerator, and in the linear accelerator obtained by "developing" the circular structure. In both cases the fields were excited by a narrow gap perpendicular to the axis, and across which a constant radio-frequency voltage was applied. (auth)

28617 (NP-10601) ABSTRACTS OF REPORTS AND COMMUNICATIONS AT THE CONFERENCE ON CYCLOTRON PROBLEMS. (5.–10. IV. 1961). (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. and Polish Academy of Sciences. Inst. of Nuclear Physics, Krakow). 1961. 137p.

Forty-four abstracts are included for papers presented at the Conference on Cyclotron Problems. The topics cover cyclotron operating experience, nuclear reactions, ion acceleration, dosimetry, etc. (D.L.C.)

28618 (TID-13417) LINEAR ELECTRON ACCELERATOR STUDIES AND PROPOSED TWO-MILE ACCELER-

ATOR PROJECT, COMBINED STATUS REPORT, APRIL 1, TO JUNE 30, 1961. (Stanford Univ., Calif. W. W. Hansen Labs. of Physics). July 1961. Contracts AT(04-3)-21 and AT(04-3)-363. 45p. (ML-827, M-272)

Work proceeded on the installation of mechanical and electrical components for the Mark-IV accelerator. A stock-control and inventory system for Mark IV was designed and implementation was started. The test setup for the measurement of gassing effects, cw heat experiments, and peak power heating experiments are nearly completed. Work is being completed on the parts for electroforming two 10-foot constant-gradient sections. A computer program was written for optical ray-tracing of electron trajectories in an accelerator. A bunching system theoretically capable of bunching 80% of the injected electrons in a 2° phase interval is discussed. An investigation was made of the possibility of chopping off at the beginning of the accelerator those electrons which it is not possible to bunch within the required energy spread of 0.1%. The r-f driver for the Mark-IV accelerator was tested. Procurement of the remaining microwave components for use on the Mark IV was accomplished. Modification in the fabrication methods of klystrons were introduced to decrease the difficulties experienced with copper gaskets used between windows. One klystron was successfully used to power the window life test rack. Modulator studies and vacuum system development is reported. The formulation of the operation and maintenance policies and procedures that influence the control system design was carried out. Studies were carried out to determine the project a-c power demands. (M.C.G.)

28619 (CEA-tr-X-234) INSTALLATION ELECTROLYTIQUE POUR LA PRODUCTION DE DEUTERIUM ET REMPLISSAGE DU RESERVOIR DE STOCKAGE A L'AIDE DE LA PRESSION ATMOSPHERIQUE. (Electrolytic Installation for Production of Deuterium and Filling the Storage Tank Using Atmospheric Pressure). F. Cordero Lopez and L. Tanarro Sanz (Spain. Junta de Energia Nuclear, Madrid). Translated into French from report JEN-63, 1959. 25p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract no. 6196.

28620 (UCRL-Trans-700) PARTIAL PRESSURE ANALYSES OF THE FINAL PRESSURE OF OIL DIFFUSION PUMPS BY THE OMEGATRON. G. Reich, and H. G. Nöller. Translated by Richard B. Mudge for Univ. of California from Z. angew. Phys., 9: 617-21(1957). 14p.

The design and operation of a omegatron mass spectrometer are reviewed briefly, and measurements of the partial pressures of gases contained in an oil diffusion pump system are reported for various oils. The use of a cooled baffle to condense decomposition products is discussed. (D.L.C.)

28621 ON THE THEORY OF THE RING CYCLOTRON. V. P. Fateev. Atomnaya Energ., 10: 373-5(Apr. 1961). (In Russian)

An attempt is made to demonstrate the existence of stable, closed orbits, considering edge effects. Special attention is given to symmetry variation in which acceleration, accumulation, and beam front interaction are taking place. The results are used in an investigation of various existing cyclotron modifications. (R.V.J.)

28622 A TRAVELLING-WAVE CASCADE GENERATOR: NEW HIGH-VOLTAGE SUPPLY FOR ACCELERATORS. V. M. Balabanov and G. A. Vasil'ev. Atomnaya Energ., 10: 375-7(Apr. 1961). (In Russian)

The construction and performance of a traveling-wave cascade generator of 250 kw, 1.5 μa (operation frequency 7 to 10 k hertz), with cascade heights of 25 mm each, and using a selenium rectifier are analyzed. The generator can be effectively utilized with a strong point, direct-action accelerator of 5 to 6 Mev and current beam up to 1 μa. (R.V.J.)

28623 AN IRON CANAL WITH A CURRENT FOR INJECTING AND EXTRACTING CHARGED PARTICLES. A. A. Arzumanov, N. I. Venikov, E. S. Mironov, and L. M. Nemenov. Atomnaya Energ., 10: 461-8(May 1961). (In Russian)

A magnetic channel is described which is capable of extracting and injecting charged particles without twisting the shape of the magnetic field. The experiments were made with a magnet having a pole piece 500 mm in diameter and a 188 mm magnet gap. The current stability of the magnet coil is 0.3%; the field measuring error did not exceed 5 gauss. The calculations for magnetic channels are correlated with experimental data. (R.V.J.)

28624 ACCELERATING SYSTEMS EMPLOYING ANALOGUES OF H-TYPE WAVES. P. M. Zeidlits and V. A. Yamnitskii. Atomnaya Energ., 10: 469-77(May 1961). (In Russian)

Linear accelerating systems employing analogues of H-type wave oscillations were rejected during the years of 1947 to 1957 because of difficulties in calculations and cumbersome experimental conditions. However, systematic measurements of volume resonators operating with H waves exhibit considerable advantages over ordinary resonators operating with E_{010} waves. Linear accelerating systems operating with H-type waves can be utilized, without alterations of the structure, with particle rates equal to C which is impossible with the E_{010} wave. The system can be applied in ion acceleration due to its ability to develop long waves in a small area and reduced consumption of high-frequency power, which is especially effective at small particle velocities. (tr-auth)

28625 A BEAM EXIT AND ENERGY REGULATION IN A CYCLOTRON WITH AZIMUTHAL VARIATION OF MAGNETIC FIELD. A. A. Arzumanov, R. A. Meshcherov, E. S. Mironov, L. M. Nemenov, S. N. Rybin, and Yu. A. Kholmovskii. Atomnaya Energ., 10: 501-2(May 1961). (In Russian)

The studies were carried out with a 1.5-m cyclotron. The magnetic field azimuthal intensity variations of nearly ±15% were produced by three 60° sectors. The acceleration and beam extraction were tested at magnetic field intensities of 5, 10, 13.6, 14.7, and 17 k gauss. The protons were accelerated up to 5 Mev and molecular hydrogen ions up to ~10, 21, 24, and 31.5 Mev. (R.V.J.)

28626 SOME ASPECTS OF THE THEORY OF A CYCLOTRON WITH AN AZIMUTHALLY VARIABLE FIELD. Yu. A. Zavenyagin, R. A. Meshcherov, and E. S. Mironov. Atomnaya Energ., 11: 26-33(July 1961). (In Russian)

It was shown previously that the acceleration of ions in a cyclotron provided with a radially increasing field is stable if the field changes intermittently in the azimuthal direction. This requirement presents technical difficulties and is actually not always necessary because the constancy of the periods of the turns needed for obtaining acceleration may be achieved under diverse conditions of the field. In analyzing the motion of ions in a radially, azimuthally or arbitrarily changing field, it was found previously that the higher harmonics exert only a slight effect, and therefore special attention was given to the cosine function type change of the field. Equations were derived for calculating the closed orbits, the period of ion turns and the minimum required voltage for determining the stability ranges.

These equations were used for calculating the basic parameters of the 1.5-m cyclotron employing a magnetic field variable in the azimuth. The results of the experimental determination of the particle motion were in good agreement with the theoretical values. (TTT)

28627 ACCELERATION OF LARGE CURRENT PULSES IN LINEAR ELECTRON ACCELERATORS. N. A. Khizhnyak, V. T. Tolok, V. V. Chechkin, and N. I. Nazarov (Inst. of Technical Physics, Academy of Sciences, Kharkov). Atomnaya Energ., 11: 34-40(July 1961). (In Russian)

The possibility of using linear electron accelerators for accelerating current pulses with energies up to several tens of Mevs presents a great interest to physical research in view of the ease of injecting and removing the beam. This question which was neglected up to now, has been investigated from the theoretical viewpoint, comparing the acceleration with stationary and moving waves. Results of the calculation show that the high-frequency stationary-wave machines used for the acceleration appear to be more promising than the usual accelerators with moving waves, especially if sufficiently powerful generators and high-frequency resonators are used. Acceleration of current pulses of the order of several hundreds of milliamps may be achieved on machines not specifically designed for high currents. (TTT)

28628 A HIGH-CURRENT ELECTRON ACCELERATOR. V. T. Tolok, L. I. Bolotin, V. V. Chechkin, N. I. Nazarov, and N. A. Khizhnayak (Inst. of Technical Physics, Academy of Sciences, Kharkov). Atomnaya Energ., 11: 41-5(July 1961). (In Russian)

A 5-Mev linear accelerator was designed and built for confirming the feasibility of the above-described accelerating system. The system consisted of two coupled generators excited by a stationary π-wave with a frequency of $137.4 \cdot 10^6$ hertz by means of 12 generators each yielding a power up to 100 kw in 400-microsec pulses. Electron current pulses of 8.5 amp lasting for 0.2 microsec with electron energies of 4.5 Mev were obtained. The maximum charge of the accelerated electrons in a single pulse was $3 \cdot 10^{-6}$ coulomb. If needed, the current could be increased to 25 amp; however in that case the energy maximum dropped to 3 Mev because of the widening of the energy spectrum. Using a pulse frequency of 15/sec an average current of 50 microamp was reached; this value could be increased by increasing the pulse frequency to 100 to 150/sec. The machine made it possible to obtain highly-charged electron clusters and it is thus of interest for the coherent proton acceleration method proposed by V. I. Veksler (Atomnaya Energiya 2, 427, No. 5(1957)). (TTT)

28629 MAGNETIC MASS ANALYSIS OF A 200 kev ION BEAM FROM A COCKCROFT AND WALTON ACCELERATOR. B. Antolković, M. Paić, K. Prelec, and P. Tomaš (Inst. Ruder Boskovic, Zagreb and Inst. of Physics, Faculty of Science, Zagreb). Glasnik mat.-fiz. i astron., Ser. II, 61-7(1960). (In English)

The ion beam of a 200 kv Cockcroft-Walton accelerator was produced in a high-frequency ion source fed with deuterium gas obtained by electrolysis of heavy water (99.6% D_2O) in the absence of air. After acceleration the ion beam passed through a magnetic mass analyzer. Tabular data and apparatus diagrams are given. It was found that a variation of accelerating voltage from 153 to 198 kv did not considerably affect the relative mass spectrum but did influence the total ion current. Higher excitation gave a higher total ion current and a higher accelerating voltage improved the focusing, in turn giving a higher ion current. (L.N.N.)

28630 PASSAGE THROUGH A QUADRATIC RESONANCE IN A SYNCHROTRON WITH STRONG FOCUSING. Kh. A. Simonyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 14: No. 2, 71-8(1961). (In Russian)

The combined effects of perturbations due to fluctuations in the quadratic nonlinearity and nonsymmetry of the magnetic field with respect to the orbital plane ($z = 0$) are considered in detailed mathematical form for a synchrotron with strong focusing. Small periodic perturbations which depend on the frequency are taken into account, since they can result in large changes in amplitude at resonance frequencies. An example is worked out numerically where the total rise in amplitude of a perturbation for n phase changes per acceleration cycle is expressed as a function of the nonsymmetry of the magnetic field. (TTT)

28631 CALCULATIONS OF ACCELERATED PARTICLE LOSSES IN SCATTERING ON GAS. A. G. Vlasov (Kirov Tomsk Polytechnic Inst., [USSR]). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 1, 20-3(1961). (In Russian)

Accelerated particle losses η in scattering on residual gas are estimated using Mott scattering cross sections based on the Thomas–Fermi statistical model. The results obtained for three proton and three electron accelerators are tabulated. (R.V.J.)

28632 TECHNICAL PROBLEMS IN THE CONSTRUCTION OF THE 28-Gev CERN PROTON SYNCHROTRON. K. H. Reich. Kerntechnik, 3: 345-55(Aug. 1961). (In German)

After a short survey on the essential theoretical relationships, the characteristic features of the Geneva 28-Bev proton synchrotron are described. The simultaneous cofunctioning of the various parts of the installation are described in detail. The solutions found at CERN for the annular magnet and its current supply as well as the high-frequency acceleration system are explained and some of the operation experiences made so far discussed. (auth)

28633 NON-SYNCHRONOUS ACCELERATION OF IONS IN CYCLOTRONS. F. M. Russell (N.I.R.N.S., Rutherford High Energy Lab., Harwell, Berks, Eng.). Plasma Phys.-Accelerators-Thermonuclear Research, J. Nuclear Energy, Pt. C, 3: 186-95(July 1961).

A particular frequency modulation program is developed with the object of storing ions in the central region of a frequency modulated cyclotron. These ions could subsequently be captured into phase-stable orbits and accelerated in the usual manner, thereby increasing the mean beam intensity obtainable from such a machine. First, a saw-tooth frequency program is considered in which the rate of frequency change is too fast for ions to be accelerated synchronously. It is shown that there is a bias toward the net acceleration of ions to higher energies. By modifying the shape of the frequency program it is found that more ions can be extracted from the source than with the simple saw-tooth shape. A frequency program resembling a blunt saw-tooth is found to give the largest gains. The perturbing effect of successive programs is examined and an estimate made of the limiting number of ions which can be stored in the center of a machine. (auth)

28634 TRANSIENTS IN ACCELERATING SYSTEM BECAUSE OF INJECTION. S. A. Kheifets and A. I. Baryshev. Zhur. Tech. Fiz., 31: 606-12(May 1961). (In Russian)

Variations of the amplitude, phase, and frequency of accelerating intensity during particle injection are studied. The examined effect is capable of limiting the accelerated particle flux unless special measures are taken. (tr-auth)

28635 THE INFLUENCE OF PRESSURE WITHIN VACUUM CHAMBER ON THE RADIATION INTENSITY OF ACCELERATORS. A. G. Vlasov. Zhur. Tekh. Fiz., 31: 613-15(May 1961). (In Russian)

Radiation emission intensities from 15- and 25-Mev betatrons are plotted as a function of pressure in the accelerating chamber at various injection intensities. It was shown that accelerators perform best with pressures of 2 to 4×10^{-6} mm mercury. Moreover, an increase in pressure to 3 to 5×10^{-5} mm mercury decreases the intensity to zero. The sharp drop in emission intensity with increased pressure is due to a decrease in scattering by residual gas. Theoretical curves of electron losses due to scattering by residual gas are also plotted. (R.V.J.)

28636 IMPROVEMENT OF SYNCHROTRON STABILITY BY USE OF ELECTROMAGNET POWER SOURCE STABILIZATION. N. N. Chernov and V. I. Chesnokov (Ioffe Inst. of Physics and Tech., Leningrad). Zhur. Tekh. Fiz., 31: 627-9(May 1961). (In Russian)

Descriptions are given of a device for stabilizing the current of a strong low-frequency self-exciting generator acting as a power supply for synchrotron electromagnets. The stabilization is based on the concept that the magnitude of the generator reverse band is proportional to the signal transducer amplitude, which in turn is a function of magnitude and sign. The generator current is plotted as a function of supply line current. (R.V.J.)

28637 LINEAR ACCELERATOR. (to Varian Associates). British Patent 875,253. Aug. 16, 1961.

A linear accelerator is designed with its bunching section or slow wave structure so constructed that the field strength and phase velocity varies with position to give optimum energy interaction between the wave and the beam. (D.L.C.)

Plasma Physics and Thermonuclear Processes

28638 (AFOSR-924) APPROXIMATE CONSTANCY OF ADIABATIC INVARIANTS IN PLASMA PHYSICS. L. M. Garrido and F. Gascón (Saragossa, Spain. Universidad). [1961]. Contract AF61(052)-438. 16p.

The interaction representation for classical mechanics starting from an operational formulation of the same is presented. General criteria to be satisfied by a slowly time-dependent Hamiltonian in order to possess adiabatic invariants of the m-th order are given. A general method, based on techniques similar to those used to evaluate time-dependent perturbations in quantum mechanics, to calculate the degree of approximate constancy of such adiabatic invariants for Hamiltonians depending slowly but at a finite rate on time is discussed. These methods were applied to the adiabatic invariants that appear in thermonuclear plasma, evaluating the errors made in the guiding center approximation. (auth)

28639 (CF-61-6-66) OBSERVATION OF IONIC SOUND WAVES IN GASEOUS DISCHARGE TUBES. I. Alexeff and R. V. Neidigh (Oak Ridge National Lab., Tenn.). June 7, 1961. 13p.

Continuous oscillations are observed in a spherical glass discharge tube excited by direct current. Besides the fundamental, higher frequencies corresponding roughly to the overtones in a spherical resonator can be excited alone. The observed fundamental frequency apparently agrees with the formula for a standing ionic sound wave: $f = (1/CD)\sqrt{(3kT_e/m_i)}$. C, a constant, can be 1.00 or 1.51 depending on the plasma boundary conditions. The electron temperature, T_e, is found by a Langmuir probe. The observed frequency dependence on sphere diameter, D, and on ion mass, m_i, agrees with the formula. Spheres of diameter 2.5, 10, and 25 cm, and ions of atomic mass 1 to 131, were studied. (auth)

28640 (CLM/R-5) HYDROMAGNETIC WAVES IN A CYLINDRICAL PLASMA. L. C. Woods (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Oxfordshire, England). June 1961. 28p.

Several extensions of the theory of hydromagnetic waves in a partially ionized gas are presented. The gas is postulated as confined in a cylindrical tube through which passes an axial magnetic field. The tube wall is assumed to be either a perfect conductor or a material of small or zero conductivity. The effects of the viscosity and compressibility of the ionized and neutral gases are included in the theory, as also are the contributions of finite conductivity and the ion–cyclotron term. The non-isotropic character of the viscosity and conductivity coefficients of the ionized gas was taken into account. A new boundary condition was derived for the insulating walls with the aid of a dipole layer of charge. A dispersion relation was obtained which allows for all these dissipative effects and which is valid for a range of frequencies which extends beyond the ion cyclotron frequency, but falls short of the frequency at which electron inertia and displacement currents become effective. (auth)

28641 (GA-2386) NON-LINEAR STABILITY OF PLASMA OSCILLATION. W. E. Drummond and D. Pines (General Atomic Div., General Dynamics Corp., San Diego, Calif.). July 11, 1961. 32p.

For presentation at the Conference on Plasma Physics and Controlled Nuclear Fusion Research, Sept. 4-9, 1961, Salzburg, Austria.

A plasma is studied that obeys the collisionless Boltzmann (or Vlasov) equation. Properties of oscillations in this plasma are found by linearizing the Vlasov equation about the unperturbed distribution function. If the solution to this equation yields an exponentially unstable plasma, the oscillations generally grow so large that the linearization of the Vlasov equation becomes invalid. In this non-linear regime, it is found that the full solution consists of two non-linear parts. One of these, combined with the linear solution, leads to an equilibrium spectrum for the instabilities. The second part provides coupling between the various oscillation modes, thus eventually damping the equilibrium spectrum to zero. (T.F.H.)

28642 (GCA-TR-61-11-A) PLASMAS. Scientific Report No. 3. R. Papa (Geophysics Corp. of America, Bedford, Mass.). Jan. 1961. Contract AF 19(604)-7405. 66p. (AFCRL-25; AD-252532)

The Boltzmann Equation is considered as a continuity equation in six-dimensional phase space. The standard methods for solving the Boltzmann equation are discussed. By taking velocity moments of the Boltzmann equation, the usual macroscopic equations may be obtained for particle conservation, momentum transport, and energy transport. When the collisions in a plasma can not be considered as distinct separate events, the Fokker-Planck equation should be used. The Fokker-Planck equation is derived from the Boltzmann transport equation. When the mean free path of the particles in a plasma is small compared with all other lengths occurring in the plasma, the continuum approach is valid. The thermodynamic variables describing the state of the plasma are related through a complete set of macroscopic equations. A discussion of waves in a plasma in-

cludes electromagnetic waves and hydromagnetic waves. The propagation characteristics of electromagnetic waves in a plasma in a constant magnetic field may be found if the components of the conductivity tensor are known. The conductivity tensor may be derived for a zero temperature plasma from particle orbit theory. It is found that, because of the presence of the magnetic field, the electromagnetic wave can not be separated into a purely transverse and purely longitudinal wave, except for special directions of propagation. A general dispersion relation, relating the index of refraction to other appropriate physical parameters of the plasma, is derived from Maxwell's equations. The existence and behavior of hydromagnetic waves in a perfectly conducting compressible fluid is demonstrated by obtaining solutions to the basic equations of motion using a perturbation technique. It is found that the presence of a constant magnetic field permits the medium to sustain three modes. One is the familiar Alfven mode, in which the mass velocity is perpendicular to the magnetic field and to the direction of propagation. The behavior of the three modes of hydromagnetic waves is investigated at an interface. A chart is included, classifying various magnetohydrodynamic regions according to ratios of critical lengths. A discussion of diffusion caused by density and temperature gradients in a plasma follows. A closed system of equations describing this diffusion is obtained by making an expansion in two small parameters: $\alpha = (a|\nabla n|/n)$ and $\gamma = 1/\omega\tau$, where a = radius of gyration, ω = ion cyclotron frequency, n = particle density, and τ = collision frequency. The stability of a plasma is considered from the point of view of the energy principle and from the point of view of the normal mode approach. The energy principle involves a virtual displacement of the magnetic field lines away from equilibrium. This virtual displacement must satisfy all the constraint equations of magnetohydrodynamics except the equations of motion. The equations of motion are then satisfied by choosing a displacement which minimizes the energy change. The normal mode approach consists in linearizing the wave equation in the plasma. A dispersion equation may be obtained relating the frequency of the wave to the propagation constant. The configuration is stable if all solutions of the dispersion equation give real values for the frequency. (auth)

28643 (MATT-67) THE EFFECT OF STRONG MAGNETIC FIELDS ON CHEMICAL ENGINEERING SYSTEMS. F. W. Camp and E. F. Johnson (Princeton Univ., N. J. Plasma Physics Lab.). Mar. 1961. Contract AT(30-1)-1238. 97p.

A detailed treatise is presented which considers the interactions and effects caused by a magnetic field, develops equations to describe these effects, and evaluates the magnitude of the effects. The effects are classified as those on equilibrium thermodynamic properties, physical and chemical rate processes, and fluid flow. It is concluded that, for observable magnetic effects, extremely low temperatures and/or extremely high magnetic fields are required, and that magnetic effects are insignificant for ordinary materials. (D.L.C.)

28644 (MATT-Q-14) QUARTERLY REPORT [ON PROJECT MATTERHORN], COVERING THE PERIOD JANUARY 1—MARCH 31, 1961. (Princeton Univ., N. J. Plasma Physics Lab.). May 5, 1961. Contract AT(30-1)-1238. 35p.

Preliminary results were obtained on the onset of enhanced particle diffusion in the B-3 stellarator. In the quiescent afterglow plasma following ohmic heating a small alternating voltage produced a small current which increased as the temperature of the plasma rose. The rate of loss of electrons increased sharply when the current was about equal to the theoretical value predicted for the appearance of ion-wave instabilities. Identification of these instabilities as the cause of enhanced diffusion was strongly suggested, though not firmly demonstrated. Measure of oscillating magnetic field strengths, wavelengths, and plasma density in B-66 demonstrated relatively close agreement with the theoretical dispersion relation for ion cyclotron waves. The measured flux of energy in these waves was about 100 kw. Installation of the Model C stellarator was essentially completed except for stage II components. The device was successfully pulsed to 30,000 gauss. (auth)

28645 (TID-12845) RESONANT ELECTROMAGNETIC MODES IN GYROELECTRIC PLASMAS. Technical Report No. 5. Joseph J. Stafford (Illinois. Univ., Urbana. Electrical Engineering Research Lab.). Mar. 1, 1961. Contract AT(11-1)-392. 97p.

The existence of resonant electromagnetic modes in a cylindrical gyroelectric plasma bounded by two parallel metal endwalls was theoretically and experimentally verified. An unloaded Q of 5800 and a shunt impedance of 15.25 kilohms was measured in the 10 kmc range. These resonant modes had axial phase velocity ratios v_p/c less than one, thereby permitting synchronous coupling to an electron beam, and they were tunable with the DC magnetic field. The cross-sectional dimensions of the plasma resonator can be large compared to wavelength while the fields are in a low order, symmetrical, mode. Maxwell's equations were solved rigorously in the anisotropic medium with a minimum of restrictive assumptions and after applying the appropriate boundary conditions, a characteristic equation was found. After investigating the whole frequency spectrum to find regions in which real solutions to the characteristic equation are obtainable, this equation was solved in the 10 kmc range using numerical techniques. Plots of radii vs driving frequency for two lengths, five magnetic fields and three plasma frequencies were made. Then for fixed radius, length and plasma frequency, a plot was made of magnetic field vs driving frequency. An analysis was made of similar modes but neglecting propagation effects (static modes) and the regions of the spectrum in which this approximation is valid was determined. A comparison was then made between similar modes for both the static and dynamic cases. The experimental verification of both the static and dynamic modes was made using a PIG (Philips ionization gauge) discharge. The characteristics of the PIG discharge are ideally suited to the geometrical configuration and assumptions employed in the analysis of the plasma resonator. Resonances were plotted for two different plasma lengths and two radii using three different modes. This device has applications as a coupling structure for use in conjunction with electron beams. Due to its high shunt impedance, its slow wave properties, and its large physical size, it is believed that the resonator can have use in the ultramicrowave region. In addition, with certain modifications the resonator can be used as a plasma diagnostic tool to measure plasma densities. (auth)

28646 (AEC-tr-4381) DISPERSION RELATIONS OF PLASMA OSCILLATIONS. Ikuo Kaji and Yasutomo Ozawa. Translated from J. At. Energy Soc. Japan, 2: 182-9(1960). 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 15391.

28647 (NP-tr-717) JOURNAL OF TECHNICAL PHYSICS (SELECTED ARTICLES). Translated from Zhur. Tekh. Fiz., 31: No. 4, 407-18; 419-27(1961). 37p.

Two articles are translated covering the propagation of MHD surface waves in plasma and shock wave effects in magnetohydrodynamic media. Both articles are abstracted separately. (T.F.H.)

28648 (NP-tr-717(p.1-20)) MAGNETOHYDRODYNAMIC SURFACE WAVES. L. S. Solov'ev. Translated from Zhur. Tekh. Fiz., 31: 407-18(1961).

A study is presented of nonlinear waves on a plane surface of an incompressible ideally conducting plasma, in the presence of an external magnetic field. Equations are given for the stationary spiral flow of an incompressible plasma, and the stability of a plasma cylinder rotating about its axis is considered in linear approximation, with the aid of these equations. (auth)

28649 (NP-tr-717(p.21-37)) SHOCK IONIZATION AND DETONATION IN MAGNETOHYDRODYNAMICS. V. P. Demutskii (Demutskiy) and R. V. Polovin. Translated from Zhur. Tekh. Fiz., 31: 419-27(1961).

A study is made of the possible regimes of shock ionization and shock detonation caused by the motion of a conducting piston in a magnetohydrodynamic medium. The types of waves accompanying these ionization and detonation waves are also studied. The magnetic field is allowed to have any direction with respect to the shock wave, and the effects of the ionization energy of the gas are taken into account. (T.F.H.)

28650 (NP-tr-726) THE THEORY OF EXCITATION OF STANDING WAVES IN PLASMA. R. Leven. Translated from Vestnik Moskov. Univ. Ser. III. Fiz., Astron., No. 4, 32-7(1960). 9p.

A dispersion equation is derived for standing waves, excited by an electron beam, in a bounded plasma. This equation enables the determination of frequencies and frequency increments, for any ratio of beam density to plasma density. (auth)

28651 THE STABILITY OF STATIONARY MAGNETOHYDRODYNAMIC MOTIONS. PART II. Cataldo Agostinelli. Atti accad. nazl. Lincei. Rend., Classe sci. fis., mat. e nat., 30: 3-10(Jan. 1961). (In Italian)

By assuming that the displacement is infinitesimal and that the higher order terms can be neglected, the differential equation of the small oscillations and a complete equation of the second degree in the pulsation are deduced. Since the existence of a displacement which makes the frequency of oscillation, or pulsation, imaginary gives place to instability, an inequality from which a limit of the instability of this oscillation is established. It is then shown how the extreme values of the pulsation belong to the total result of its self-value. The case of motion internally uniformly rotating around an axis is considered and the effect of centrifugal force is studied. (J.S.R.)

28652 CHARGED PARTICLE BEAM INTERACTIONS WITH ELECTRON PLASMA. A. I. Akhiezer and Ya. B. Fainberg (Inst. of Physics and Tech., Kharkov). Doklady Akad. Nauk S.S.S.R., 119: 555-6(1949). (In Russian)

Non-modulated electron beams, with velocity not exceeding the mean plasma electron thermal velocity, penetrating through unrestricted plasma excite longitudinal electric waves with exponentially rising amplitudes. The beam itself also becomes unstable. It was also observed that the passage of a non-modulated charged particle beam through a waveguide filled with dielectric or through bound endovibrators induces increasing field waves and charged beam density similar to plasma. (R.V.J.)

28653 PLASMA ENGINEERING. PART III. APPLICATIONS OF PLASMA. Michael F. Wolff, ed. Electronics, 34: No. 35, 29-35(Sept. 1, 1961).

Practical applications of plasma are studied and used in controlled thermonuclear fusion experiments, magnetohydrodynamic and thermionic power conversion, spacecraft propulsion, and electronics. Specific examples are given for each of the fields covered above. Specific electronic applications are microwave traveling-wave amplifiers, backward-wave oscillators, uhf parametric amplifiers, phase detectors, harmonic amplifiers, mixers, and switches. Other devices where plasma is confined include stellarators, magnetic mirror machines, self-confinement devices, astrons, and rotating plasma devices. (N.W.R.)

28654 LAMINAR NATURAL CONVECTION FLOW IN MAGNETO-HYDRODYNAMICS. G. Poots (Bristol Univ., Eng.). Intern. J. Heat and Mass Transfer, 3: 1-25(Aug. 1961). (In English)

The two-dimensional laminar natural convection flow of an electrically conducting viscous fluid, such as mercury or liquid sodium, in the presence of electric or magnetic fields, is discussed. The first example considered is the steady fully developed natural convection flow, with and without heat sources, between two long parallel plane surfaces with uniform magnetic field applied normal to the surfaces. The plane vertical surfaces are open at both ends to the ambient fluid and are maintained at constant temperatures different from that of the ambient fluid. Tables are given from which the fully developed temperature, velocity and induced magnetic fields may be found. Flow characteristics such as the net mass flow and wall Nusselt numbers are also evaluated. The second example is the steady two-dimensional natural convection flow set up by Joule heating when a direct current flows in the axial direction through a horizontal circular tube filled with an electrically conducting viscous fluid. The outside surface of the tube is maintained at constant temperature by a coolant which is assumed to be a non-conductor and non-magnetic. The influence of the non-uniform convection flow on the temperature distribution and wall Nusselt number is calculated. (auth)

28655 CONTRIBUTIONS TO THE THEORY OF NONLINEAR OSCILLATIONS OF PLASMA. S. M. Khzardzhyan (Moscow State Univ.). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 12: No. 6, 123-31(1959). (In Russian)

The theory of plasma oscillation has been developed previously within the framework of linear approximation methods. In the present work the theoretical basis of a nonlinear theory of plasma oscillations was developed, taking a perturbation approach and expanding the distribution function in a series of powers of the density change to mean value ratio. The effect of this expansion on the solution of the Vlasov equation is examined for the case of longitudinal waves. It was found that in the second approximation the phenomenon of an "acoustical wind" is displayed. The temperature dependence of the current density is also determined. (TTT)

28656 KINETIC APPROACH TO THE INTERACTION OF A STREAM OF CHARGED PARTICLES WITH A STATIONARY PLASMA IN THE MAGNETIC FIELD. [PART] I. M. S. Kovner (Gorkii State Univ., USSR). Izvest. Vysshykh Ucheb. Zavedenii, Radiofiz., 3: 631-44(1960).

Discussion is given (based on the kinetic-equation method) of the instability of a stream of charged particles passing through a stationary magneto-active plasma and conditions are determined for wave amplification. It is assumed that the plasma and the stream are not bounded and that the ordered stream velocity v_0 is in the direction of the external magnetic field H_0. The direction of propagation of the waves is taken to be arbitrary and is determined by a wave vector k which makes an angle α with the direc-

tion of the external field H_0. In the absence of this stream three types of waves can be propagated, namely, extraordinary, ordinary, and plasma. In the presence of a stream having a sufficiently low intensity, the refractive index for the above waves is changed only very slightly. However, in distinction to the case $v_0 = 0$, it is possible for the waves to be amplified. Moreover, the order of the dispersion equation for the interaction of a stream with the plasma is increased and hence new types of waves can be propagated. In some cases, the instability may be associated with the amplification of this type of wave. A general dispersion equation is derived which determines the propagation of high-frequency waves in a magneto-active plasma. This equation is used in a discussion of the stability of plasma waves, and the stability and amplification (damping) coefficients for the extraordinary and ordinary waves are determined. The discussion takes into account thermal motion of particles in the stream. The results obtained by the kinetic-equation method for the instability of a stream of charged particles in a plasma and the amplification of electro-magnetic waves is interpreted in terms of the radiation emitted by electrons in a plasma. When charged particles move through a magneto-active plasma having a refractive index greater than unity, coherent bremsstrahlung and Cherenkov radiations are produced. The kinetic energy associated with the translational motion of the particles is thus partly converted into radiational energy and the density of this energy may increase. The part played by the plasma in this process is as follows. On the one hand, it ensures that the refractive index is in fact greater than unity, it retards the waves, and on the other hand, even in the absence of collisions, the amplification is prevented by the Landau effect. If the concentration of the particles in the stream is sufficiently high, the Landau damping cannot prevent the amplification of the field and the system becomes unstable (on the linear approximation). (OTS)

28657 ACCELERATION OF RIGID, CONDUCTING, DIAMAGNETIC BODIES BY A MAGNETIC FIELD. R. U. Ayres (G. C. Dewey Corp., New York). J. Appl. Phys., 32: 1549-56(Aug. 1961).

A scheme is developed for treating very fast acceleration processes involving plasmoids. The plasmoid is assumed to move approximately as a rigid body during the acceleration. Two coupled nonlinear differential equations must be solved simultaneously. A power series development valid for short times is given. Two examples are treated which are reminiscent, respectively, of exploding wires in the one case, and certain propulsion devices in the other case. Apart from an analysis of the first two terms in the power series development, no numerical work is attempted. The result of the analysis is that the kinetic energy acquired by the plasmoid can quite generally be expressed as a function of distance traveled, in the form $\frac{1}{2}\, mx^2(x) = C'[\frac{1}{2}\,(\partial L/\partial x)|_{x=0}]^{\frac{1}{3}}\ \{x^{\frac{4}{3}} + \frac{1}{3}\,[(\partial^2 L/\partial x^2)/(\partial L/\partial x)|_{x=0}]\ x^{\frac{5}{3}} + \ldots\}$, where L(x) is the inductance of the total circuit, depending on the location of the plasmoid and its shape, and C′ is an experimentally determined constant depending on the circuit parameters and plasmoid mass prior to acceleration. The above expression is only valid for short distances (times). (auth)

28658 TRANSFORMATION OF OBSERVED RADIANCES INTO RADIAL DISTRIBUTION OF THE EMISSION OF A PLASMA. Kjell Bockasten (Univ. of Uppsala). J. Opt. Soc. Am., 51: 943-7(Sept. 1961).

A new method for transforming observed radiances into the radial distribution of the emission of a plasma is described. It is applicable to optically thin plasmas with cylindrical or spherical symmetry, which are often encountered in plasma physics and astrophysics. The observations are introduced as a sequence of n readings on the experimental curve, which are then transformed to a set of values for the emission coefficient. The transformation coefficients are tabulated for n = 10, n = 20, and, in part, for n = 40. The method is more accurate than previously published ones and is well suited for rapid calculation by electronic computers. The sources of errors are discussed and a numerical method for smoothing the readings is suggested. (auth)

28659 THE CONFINEMENT OF PLASMA BY THE HELIOTRON MAGNETIC FIELD. Kōji Uo (Kyoto Univ.). J. Phys. Soc. Japan, 16: 1380-95(July 1961). (In English)

A magnetic field named the Heliotron field is produced by the electric current in a series of pair coils wound around the discharge tube with regular intervals. The electric current in each coil of the pair differs both in intensity and direction. The lines of force in this field undulate near the tube axis without cutting the wall, while those near the tube wall cross the wall. Thus the high temperature plasma can be produced by ohmic heating in the central region of this field being prevented from touching the wall. This field is found to satisfy the necessary condition for the equilibrium. The interchange instability of the plasma confined in this field is discussed. A general expression is given for the magnetic field, and it is shown that the Heliotron B magnetic field, the cylindrical cusp field, the helical winding field of the Stellarator and the Picket-Fence field are derived as special cases of this general formula. (auth)

28660 SCATTERING OF MICROWAVES FROM A CYLINDRICAL PLASMA IN THE BORN APPROXIMATION. [PART] II. Yukio Midzuno (Tokyo Univ.). J. Phys. Soc. Japan, 16: 1403-17(July 1961). (In English)

The scattering of a microwave, which is fed by an oscillating electric dipole, is treated in the Born approximation. When the source is a dipole $p_0 e^{j\omega t} e_z$, where e_z is a unit vector in the z direction, the scattered field from a collisionless cylindrical plasma is given by $E_s(r,t) = p_0\sqrt{(\pi/2)}\, e^{(3/4)\pi j}\, [k^4/\sqrt{kl\rho}\,(1+\rho)]\ e^{j(\omega t - kl - k\rho)} \int_0^\infty \eta(\rho') J_0[2k\rho' \sin(\theta/2)]\rho' d\rho' e_z$, where $(l, \pi, 0)$ and $(\rho, \theta, 0)$ are the cylindrical coordinates of the source and the observing point, respectively; $\eta(\rho')$ is ω_p^2/ω^2 with the plasma frequency ω_p and here only the term lowest in $1/kl$ and $1/k\rho$ is retained. Formulas are also derived to the next order in $1/kl$ and $1/k\rho$, when the plasma has collision loss and the dipole source has the axis in any one of the three independent directions. Remarks and discussions are given on the nature and the accuracy of the formulas. Finally the cases, where the observing point does not lie on the plane z = 0, are treated in the lowest order in $1/kl$ and $1/k\rho$. (auth)

28661 THE HALL EFFECT IN THE VISCOUS FLOW OF IONIZED GAS BETWEEN PARALLEL PLATES UNDER TRANSVERSE MAGNETIC FIELD. Hiroshi Sato (Tokyo Univ.). J. Phys. Soc. Japan, 16: 1427-33(July 1961). (In English)

The electrical conductivity of an ionized gas is anisotropic in the presence of magnetic field (Hall effect). The conductivity is expressed by a tensor in the same form for both fully and partially ionized gases. By the use of modified Ohm's law and conventional magnetohydrodynamical equations the incompressible viscous flow between parallel plates under the transverse magnetic field is analyzed and an exact solution is obtained when the magnetic Reynolds number is small. The numerical results reveal a remark-

able effect of anisotropy of conductivity. The acceleration and deceleration of viscous ionized gas under combined electric and magnetic fields are also calculated. (auth)

28662 HYDROMAGNETIC OSEEN FLOW PAST AN ELLIPTIC CYLINDER IN A UNIFORM MAGNETIC FIELD. Tosio Miyagi (Univ. of Osaka Prefecture, Neyagawa, Osaka). J. Phys. Soc. Japan, 16: 1434-46(July 1961). (In English)

The flow of a viscous, incompressible, and electrically conducting fluid past an inclined elliptic cylinder in a parallel magnetic field is discussed, making use of a perturbation method similar to Oseen approximation. Approximate formulas for the forces experienced by the cylinder are obtained only to the lowest order of the Reynolds number and the magnetic Reynolds number. The drag and lift coefficients are then expressed as functions of five non-dimensional parameters, i.e., the Reynolds number, the magnetic Reynolds number, the pressure number, the thickness-ratio and the angle of incidence of the cylinder. Numerical calculations for the drag and lift coefficients as well as their ratio are carried out for various values of these five parameters. It may be noted in the numerical results that the angle of incidence of the cylinder at which the lift coefficient has a maximum value increases with the increase of the pressure number S when $S < 1$, and the reverse is the case when $S > 1$. (auth)

28663 ON RADIATIONS FROM PLASMA IN A STATIC MAGNETIC FIELD. Kenji Mitani and Hiroshi Kubo (Kyoto Univ.). J. Phys. Soc. Japan, 16: 1480-1(July 1961). (In English)

The radiation seemingly associated with the Gross and Bernstein dispersion relation for plasma oscillation in a static magnetic field was found. Measurements were made, using a 3 cm microwave radiometer, on extraordinary waves radiated from the plasma perpendicularly to the applied magnetic field. Data, presented graphically, agreed with theoretical results. When the p-type radiations existed, the cyclotron radiation power was several decibels above the level of black body radiation. (L.N.N.)

28664 OSCILLATIONS IN A PLASMA IN A WEAK MAGNETIC FIELD. Shoji Kojima, Eiichi Kawasaki, and Kiyoe Kato (Tokyo Univ.). J. Phys. Soc. Japan, 16: 1487-8(July 1961). (In English)

Plasma oscillations in weak magnetic fields were observed (NSA 14: 18536). Similar experiments have now been performed under different conditions, and standing waves between electrodes were observed when the discharge tube had a cathode of good emission or when the tube pressure was low. The strong electron beam excites the plasma oscillation along its path. The standing waves between electrodes are formed by the beam when the plasma frequency is adequate against the distance between electrodes. (L.N.N.)

28665 THE GRAVITATIONAL INSTABILITY OF AN INFINITE HOMOGENEOUS ROTATING VISCOUS MEDIUM IN THE PRESENCE OF A MAGNETIC FIELD. G. Stephenson (Imperial Coll. of Science and Tech., London). Monthly Notices Roy. Astron. Soc., 122: 455-9(1961).

It is shown that the Jeans criterion for the gravitational instability of an infinite homogeneous medium is unaffected by the combined action of a Coriolis force, a magnetic field, and a viscous force. The necessary and sufficient conditions for stability are also discussed. (auth)

28666 MAGNETIC MIRROR CONFINEMENT OF EXPLODING WIRE PLASMA. E. J. Seykora (Florida State Univ., Tallahassee). Nature, 191: 995-6(Sept. 2, 1961).

The production and confinement of exploding wire plasmas in a magnetic mirror configuration are reported. Using $C = 1.7\ \mu F$ at 22 kv and 3 mil copper wire with no external magnetic field, the exploding wire plasma showed the well known current pause or dwell time. The beginning of the first explosion started at $t = 0$ sec, and the restrike, or second current pulse, occurred at 75 μsec. During the time of the restrike the light-emitting portion of the plasma was observed to increase in the radial direction to 4 cm. The pulse was then followed by an afterglow which continued beyond 210 μsec. The plasma never appeared to break up but continuously decreased in light intensity until photography was made impossible. (P.C.H.)

28667 SOME NOTES ON THERMONUCLEAR REACTORS. G. Martelli (Univ. of Birmingham, Eng.). Nuovo cimento (10), 19: Suppl. No. 1, 67-82(1961). (In English)

A description is given of achievements in the thermonuclear field, and some critical discussion of the principles involved in the various types of machines are examined. Construction details of the devices mentioned are found in the references given. (N.W.R.)

28668 MAGNETIC FIELD DESIGN IN THERMONUCLEAR RESEARCH. W. F. Gauster (Oak Ridge National Lab., Tenn.). Österr. Ingr.-Arch., 15: 76-87(1961). (In English)

Magnetic field and coil design, for controlled fusion research, is briefly described. Since the ohmic losses in the magnet coils are often in the order 10^6 to 10^7 watts, power optimization is important. Some basic concepts of magnet coil optimization theory are briefly reported. A diagram shows the copperweight of long solenoids matched to a 6-Mw power supply as a function of field strength and coil length. The degree of homogeneity of magnetic fields in infinite arrays of coils are calculated by forms derived by G. R. North. Magnetic mirror fields with mirror ratios of 3.5 and extremely homogeneous central zones are required for DCX machines with helical ion orbits. For the design of these fields computer codes based on the minimization of the integral over the square of the field deviation are used. The fluctuation of the magnetic field strength along the magnetic axis inside a relatively long central zone is a few parts in 10^4. A simple coil system is used for experimental investigations of stray field effects. It is designed so that the zonal harmonics through the sixth order correspond to those of the original, complicated coil arrangement. The reproduction of the external field is very good. (auth)

28669 NONLINEAR TIME-DEPENDENT PLASMA OSCILLATIONS. David Montgomery (Univ. of Wisconsin, Madison). Phys. Rev., 123: 1077-8(Aug. 15, 1961).

The Laplace transform technique employed by Landau to solve the problem of the first-order motions in an unbounded, rarified, electron plasma is modified to solve the problem to arbitrarily high order. The transforms of the nth-order contributions are expressible in terms of convolution integrals involving only terms up to order $n-1$. The method is applied to second order for the case of square-integrable disturbances. (auth)

28670 ELECTRO-HYDROMAGNETIC WAVES IN A FULLY IONIZED GAS. [PART] II. K. D. Cole (Dept. of External Affairs, Melbourne). Planetary Space Sci., 5: 292-8(Aug. 1961).

The propagation of hydromagnetic and low frequency radio waves in all directions in a fully ionized gas in a magnetic field is examined. For longitudinal and transverse propagation the addition of one extra term in the magneto-ionic formulas (without collisions) accounts for the presence of heavy ions. The partition of energy of disturbance between

kinetic (K) and magnetic (M) forms for longitudinal propagation of all frequencies is given by $K = V^2Mk^2(1 - \omega^2/k^2c^2)^2/\omega^2$, where V is the Alfvén speed. Thus approximate equipartition may exist for some audio- and radio-frequencies in the earth's exosphere. (auth)

28671 THEORETICAL STRUCTURE OF PLASMA EQUATIONS AND APPLICATION TO A SIMPLE PROBLEM. Joseph Slepian. Proc. Natl. Acad. Sci. U. S., 47: 1173-5 (Aug. 1961).

The equation developed by Rosenbluth and Rostoker for the "collision-free" transport of a plasma is discussed. It was concluded that the elimination of $(\partial f_1/\partial t)_{coll}$ from the equation is not justified. The equation was applied to the circular distribution of a high-temperature plasma in a circular long straight insulating tube whose walls are kept cold enough to condense all the ions that reach them. (M.C.G.)

28672 DEVELOPMENT OF LOCALIZED PLASMA OSCILLATIONS AND CONCENTRATION GRADIENTS. D. W. Mahaffey, G. C. McCullagh, A. Garscadden, and K. G. Emeleus (Queen's Univ., Belfast). Proc. Roy. Irish Acad., A61: No. 9, 77-88(July 1961).

Results are described of probe measurements of plasma-beam oscillations and of plasma electron temperatures and concentrations, in some low-pressure hot-cathode inhomogeneous discharges. These results show how oscillations develop in the interelectrode space, from a low amplitude form close to the anode, through a form occupying most of the space, to an intense form in which there is an oscillating sheet detached from the cathode and separated from it by an apparently non-oscillating layer of plasma. Some correlation is found between growth or decay of oscillations and motion of the electron beam down or up a plasma concentration gradient, which correlation is in general accord with plasma dispersion theory. Attention is called to the uncertainty caused by the perturbative effects of the probe on the plasma, and to the corresponding uncertainty in the interpretation of some features of the probe current and oscillation characteristics. (auth)

28673 ELECTRON ENERGY DISTRIBUTIONS IN PLASMAS. IV. OXYGEN AND NITROGEN. J. B. Thompson (University Coll., London). Proc. Roy. Soc. (London), 262: 503-18(Aug. 8, 1961).

The Druyvesteyn method of measuring electron energy distributions in low pressure plasmas was applied to cold-cathode direct current glow discharges in oxygen and nitrogen at pressures in the range 0.010 to 0.050 mm Hg. Two discharge modes occurred in both gases. Mass spectrometer measurements showed that in nitrogen only N_2^+ was present but in oxygen the ions O^-, O_2^-, O^+, O_2^+, were all present. O^- and O_2^+ concentrations were about equal in magnitude and formed over 90% of the ions present. Electron energy distributions in the positive column showed three groups in oxygen and nitrogen. The data available from the oxygen discharge are consistent with the lowest energy peak being a manifestation of a large negative ion concentration ($n_-/n_e = 20$). (auth)

28674 THE KINETIC EQUATION FOR PLASMAS AND ITS SOLUTION. Tohru Morita (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 843-5(May 1961). (In English)

The kinetic equation to be solved to calculate the conductivity of low-density high-temperature and high-density low-temperature plasmas is given, and the method for calculating the transport coefficients are indicated. Quantum statistics is not considered. (L.N.N.)

28675 ON THE STRUCTURE OF GENERALIZED FOKKER-PLANCK EQUATION OF A HIGH TEMPERATURE PLASMA. Yoshi H. Ichikawa and Yutaka Sasakura (Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 25: 989-1005(June 1961). (In English)

The structures of the generalized Fokker-Planck equation derived previously are examined in detail by considering the motion of electron beam in a high temperature electron plasma. The dynamical shielding factor provides the basis of a unified theory of the plasma oscillations and the static shielding of the particles interaction in the plasma. The friction and diffusion coefficient are calculated by taking into consideration the non-local space-time correlation effect. It is shown that the non-local correlation effect substantially modifies the contributions of the plasmon emission process. Rough estimation of the friction coefficient shows that the non-local correlation effect may increase the amount of the frictional drag at higher velocity. This effect may be essential to resolve the Langmuir paradox. (auth)

28676 THE PRESENT OUTLOOK FOR CONTROLLED THERMONUCLEAR FUSION. George Warfield (RCA Labs., Princeton, N. J.). RCA Rev., 22: 122-30(Mar. 1961).

Efforts toward the development of controlled thermonuclear fusion based on very-high-temperature plasma confinement are discussed, along with reasons for the conclusion that concentration in fusion research will shift to a study of basic plasma physics. (L.N.N.)

28677 INTRODUCTION TO THE THEORY OF SYNCHROTRON RADIATION. G. Toraldo di Francia (Università, Florence). Rend. Scuola intern. fis. "Enrico Fermi," Corso XII (1959), 414-23(1960). (In English)

The cyclotron radiation emitted by an electron is determined. The treatment is valid up to extremely relativistic energies. The critical frequency (i.e., the lowest frequency at which cyclotron radiation is emitted, is found as a function of the angle between the orbital axis of the electron and the direction of emission. (T.F.H.)

28678 RADIO-EMISSION FROM ZETA. D. J. H. Wort (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Rend. Scuola intern. fis. "Enrico Fermi," Corso XII (1959), 424-8(1960). (In English)

The radio noise from the Zeta assembly is studied at wavelengths of 4.2 and 8.6 mm, as a function of the condenser bank voltage, the initial pressure, and the temperature. Models are proposed to explain the emission phenomena. (T.F.H.)

28679 A KINETIC EXAMINATION OF SOME EQUILIBRIUM PLASMA CONFIGURATIONS. A. I. Morozov and L. S. Solov'ev. Zhur. Eksptl'. i Teoret. Fiz., 40: 1316-24(May 1961). (In Russian)

One-dimensional plasma configurations, with effective size of the order of the Larmor radius, are considered. (auth)

28680 QUANTUM THEORY OF ACOUSTIC OSCILLATIONS OF AN ELECTRON-ION PLASMA IN A MAGNETIC FIELD. P. S. Zyryanov (Urals Polytechnic Inst., [USSR]). Zhur. Eksptl'. i Teoret. Fiz., 40: 1353-9(May 1961). (In Russian)

Conditions for acoustic excitations are studied by quantum dispersion equations for electron-ion plasma. It is shown that in strong magnetic fields longitudinal ultrasonic vibrations with a wave vector perpendicular to the magnetic field vector degenerate into ion vibrations, since in this case the screening radius becomes infinite. The decay frequency of ultrasonic waves moving along the magnetic field as well as across it is calculated. The decay frequency is found to oscillate depending on the magnetic field strength. (auth)

28681 ON THE DISPERSION EQUATION FOR AN ORDINARY WAVE MOVING IN A PLASMA PERPENDICULAR TO AN EXTERNAL MAGNETIC FIELD. Yu. N. Dnestrovskii and D. P. Kostomarov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 40: 1404-10(May 1961). (In Russian)

A general qualitative investigation is carried out on the dispersion equation for an ordinary wave moving in a plasma perpendicular to an external magnetic field. The regularities found are illustrated by some results of a numerical solution of the dispersion equation. (auth)

28682 SOME PROPERTIES OF A THIN PLASMA OF VARIABLE DENSITY. Lennart Simons (Univ. of Helsinki). Soc. Sci. Fennica, Commentationes Phys.-Math., 24: No. 3, 1-16(1959). (In English)

A plasma in an axial magnetic field is considered whose density function decreases continuously in the direction of increasing radius, with the density gradient being fixed and finite. It is observed at every instant, and in every cross section perpendicular to the cylinder axis, electron currents exist in opposite directions, so that the total electron current equals zero. The currents change direction every half period. The sheet current that arises at constant plasma density is a special case depending on the fact that the density rapidly approaches zero at the plasma boundaries. Because of the ion motions, a magnetic field is induced that has different strength for ions at different distances from the axis. This phenomenon is due to the fact that the more remote ions have higher velocities. Instead of the original confinement field an inhomogeneous field thus arises. This field initiates a phase difference for ions at different distances from the axis. This phase difference increases with time and may give rise to very favorable conditions for impacts. For variable plasma density, the expression for this phase difference contains the same expression for the density gradient as does the expression for the electron current density. Thus there is a connection between the phase difference for ions at different distances and the electron current density. A specific consequence of this is that a strong sheet current is followed by strong turbulence at the boundary. (auth)

28683 THE INFLUENCE OF INDUCTION OF ION AND ELECTRON CURRENTS IN A THIN PLASMA. Lennart Simons (Univ. of Helsinki). Soc. Sci. Fennica, Commentationes Phys.-Math., 24: No. 6, 1-9(1960). (In English)

Induction effects on the ion motions and electron currents in a thin cylindrical deuterium plasma are calculated. The plasma is embedded in a confinement field and is heated by ion-cyclotron heating. Calculations are carried out for energies up to the fusion threshold, both for constant plasma density and for a density dropping to zero at the plasma boundary. Simple formulas for the relative phase shift between ions at different distances from the cylinder axis are thus obtained. Formulas for the corresponding phase shifts of the electron currents are also obtained. (auth)

28684 A SPECTROSCOPIC INVESTIGATION OF A TOROIDAL DISCHARGE. V. G. Averin, M. A. Mazing, and A. I. Pisanko. Zhur. Eksptl'. i Teoret. Fiz., 41: 42-8 (July 1961). (In Russian)

The time dependence of the line intensity of ions of various degree of ionization is studied by spectroscopically investigating the plasma glow in the "Beta" installation under different experimental conditions. The results are interpreted on the basis of corresponding changes in plasma electron temperature. (auth)

28685 INTERACTION OF TRANSVERSE OSCILLATIONS IN A PLASMA. A. P. Kazantsev and I. A. Gilinskii (Inst. of Radiophysics and Electronics, Siberian Branch, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 154-8 (July 1961). (In Russian)

The role of a nonlinear effect connected with the influence of the magnetic field of transverse waves on a plasma is discussed. It is shown that if the frequency difference of two-transverse waves equal the plasma frequency (resonance interaction) the waves will be modulated. Only a weak frequency shift is observed in the case of nonresonance interaction. The adiabatic invariants of the problem under consideration are determined. (auth)

28686 THE ELECTROMAGNETIC PROPERTIES OF A RELATIVISTIC PLASMA. [PART] III. V. P. Silin and E. P. Fetisov (Lebedev Inst. of Physics, [Moscow]). Zhur. Eksptl'. i Teoret. Fiz., 41: 159-70(July 1961). (In Russian)

The problem of reflection and absorption of electromagnetic waves striking at an oblique angle the plane bounding an electron plasma is considered. The main difference between oblique incidence and the case of normal incidence previously considered is that inside the plasma longitudinal waves are excited near frequencies for which the longitudinal dielectric permeability of the plasma vanishes. In the particular case of nonrelativistic temperatures the energy spent in exciting longitudinal waves exceeds the energy lost as a result of collisions between the plasma particles providing that the condition $(25N_eL^2 \ll T_e^4 \sin^2\theta\,(1-\omega_{Le}^2/\omega^2)$ is satisfied. (auth)

28687 ON THE THEORY OF ELECTROMAGNETIC FLUCTUATIONS IN A NONEQUILIBRIUM PLASMA. F. V. Bunkin (Lebedev Inst. of Physics, [Moscow]). Zhur. Eksptl'. i Teoret. Fiz., 41: 288-93(July 1961). (In Russian)

The components of the tensor $\varphi_{\alpha\beta}(\omega)$ of the spectral intensity fluctuations of an electric current in a nonrelativistic magnetoactive plasma located in a strong constant or rapidly alternating electric field are calculated. Expressions are also derived for the components of the effective temperature tensor $T_{\text{eff}}^{\alpha\beta}(\omega)$ the introduction of which is a formal extension of the well known fluctuation-dissipation theory (Nyquist formula) to the case of a nonequilibrium plasma. Some particular cases are considered. (auth)

28688 MAGNETO-SOUND IONIZATION OF PLASMA. E. K. Zavoiskii, I. A. Kovan, B. I. Patrushov, V. D. Rusanov, and D. A. Frank-Kamenetskii. Zhur. Tekh. Fiz., 31: 513-17(May 1961). (In Russian)

A magnetic sound method is used for preparing plasma which is not restricted by plasma frequencies and variable field interactions with electric vectors perpendicular to the static magnetic field. Electrons gather the necessary energy for future ionization in constant crossed fields, where sufficient drift velocity is developed for ionization, or in applied transverse variable electric fields, where oblique waves with electron vector components along the magnetic field form under certain conditions. A model plasma source with magnetic sound ionization was constructed on the basis of obtained data. The plasma from the source in a magnetic field flows along the field into the measuring area. Experiments indicate a plasma cylinder with 10^{12} cm^{-3} concentration in a 6-cm diameter at a nominal generator capacity of 4 kw. The operational frequency in all experiments was higher than that in a weak magnetic field in which drift motion produces electrons with ionizing energy. It is also shown that oblique waves did not affect the ionization mechanism. (R.V.J.)

28689 MAGNETIC COMPRESSION OF PLASMA. I. M. Zolototrubov, Yu. M. Novikov, N. M. Ryzhov, I. P. Skoblik, and V. T. Tolok (Khar'kov Inst. of Physics and Tech., Acad-

emy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 31: 581-21(May 1961). (In Russian)

Experiments on constriction of heated plasma by relatively slow magnetic fields are described. Previous work used shock waves excited by a side spur on the discharge tube, while the described experiments used shock waves produced by electrodeless induction discharge. The scheme of the installation shows shock excitation by a single-turn coil placed near the main field coil. High-speed pictures of shock wave propagation along the tube axis are shown. (R.V.J.)

28690 PLASMA CONDUCTIVITY IN A STRONG ELECTRIC FIELD. V. D. Shapiro (Khar'kov Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 31: 522-8(May 1961). (In Russian)

Slowing down runaway electrons caused by an external electric field $E_0 > E_{cr}$, resulting from field interactions with plasma collective oscillations, is studied. The maximum electron beam pulse magnitude and its development time are found. (tr-auth)

28691 MEASUREMENTS OF PLASMA TEMPERATURE IN THE MAGNETIC MIRROR SYSTEM. I. ELECTRON MODEL. V. A. Ovsyannikov, D. G. Bylyginskii, B. V. Galaktionov, and K. A. Dolmatova (Ioffe Inst. of Physics and Tech., Leningrad). Zhur. Tekh. Fiz., 31: 577-81 (May 1961). (In Russian)

A method is suggested for measuring directly the distribution of electron and ion plasma components. The results obtained with an electron model show the feasibility of the suggested method in application to slow magnetic mirrors. (R.V.J.)

28692 HARTMANN PROBLEM IN MAGNETIC PLASMADYNAMICS. A. I. Gubanov and O. E. Pushkarev (Ioffe Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 31: 621-3(May 1961). (In Russian)

Equations previously developed for plasma motions, considering magnetic field viscosity, are applied for plasma motions between two stationary planes when the magnetic field is distributed along the Z axis perpendicular to the planes. In the first approximation the induction fields are not considered, however, they are considered in subsequent analyses. (R.V.J.)

28693 APPROACHES TO THERMONUCLEAR POWER. R. F. Saxe. "Nuclear Engineering" Monographs. London, Temple Press Limited, 1960. 73p.

The theory of high-energy plasma is reviewed. The economic and physical feasibility of power-producing plasma reactors is studied. The properties and performances of linear-pinch, toroidal-plasma, and magnetic-mirror devices are outlined. (T.F.H.)

28694 IMPROVEMENTS IN PLASMA DISCHARGE APPARATUS. Henry Albert Howard Boot (to United Kingdom Atomic Energy Authority). British Patent 874,993. Aug. 16, 1961.

An apparatus is designed for producing and confining a plasma at temperatures $\geq 10^6$°K, using r-f power. The apparatus comprises a toroidal container within which a gas is subjected to r-f fields. The container and plasma form a r-f resonant circuit in conjunction with a magnetron. (D.L.C.)

28695 METHOD AND APPARATUS FOR PRODUCING PINCH DISCHARGE. (to U. S. Atomic Energy Commission). British Patent 875,029. Aug. 16, 1961.

An evacuated pinch discharge chamber is designed for the production of stable plasmas. After a discharge is established in the gas in the chamber, a symmetrical H_z magnetic field is applied about the discharge path and programmed to vary with the plasma compression. In this way, the external conductivity of a pinch discharge is used to provide magnetic field distributions which stabilize such discharges. (D.L.C.)

Shielding

28696 (GEAP-3199) SHIELDING OF A 27,300 SHP BOILING WATER REACTOR MARINE PROPULSION SYSTEM. W. D. Craig (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). July 25, 1959. 52p.

The radiation and shielding analysis for a 30,000 SHP natural circulation boiling water reactor for ship propulsion is summarized. The reactor is proposed for installation in a 60,000 DWT, 18-knot tanker of the T-7 class. The major contributor to side shielding dose rate is the stainless steel shroud which forms the inside wall of the downcomer annulus. A method of calculating the N^{16} activity in the primary steam which considers the competing nuclear reactions within the core was used. It was calculated that engine room radiation levels will be between 150 and 230 mr/hr at full 30,000 SHP. Dose rate from core-contained fission products will be of the order of 10 mr/hr, one day after shutdown. (M.C.G.)

28697 (HW-68023) DEVELOPMENT OF GAMMA AND NEUTRON RADIATION DATA FOR THREE ALTERNATE DESIGN CONCEPTS FOR THE PLUTONIUM RECLAMATION FACILITY, PROJECT CAC-880. H. A. Moulthrop (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 4, 1961. 56p.

Effects of gamma and neutron radiation are calculated for a Plutonium Reclamation Facility. Shielding requirements to give a dose rate around the equipment of approximately 2 mrem/hour for each of three design alternates are given. With ½ inch of lead on the hermetically sealed equipment, the working area dose rates are lowered to below 1.0 mrem/hour. With the one inch of lead shielding presence of fission products in the plutonium stream becomes a controlling factor in the extent to which gamma dose rates can be reduced in the working area. The impracticality of performing glove box operation through an 8-inch hood wall as necessary with a 6-inch plexiglas neutron shield requires either acceptance of a 10 mrem/hour minimum radiation dose rate through one inch of lead or a change of design to reduce neutron dose rates. Extrapolation of potential dose rates to the hands for plutonium indicates a possible exposure of 100 mr/hour or more in terms of equivalent body dose rates. Elimination of all glove box operations with the hermetic equipment approach suggests its eventual adoption on all plutonium processing facilities involving contact mainteance. (auth)

28698 (NP-10566) MONTE CARLO CALCULATIONS ON THE REFLECTION AND TRANSMISSION OF SCATTERED GAMMA RADIATIONS. Final Report, July 1961. Dominic J. Raso (Technical Operations, Inc., Burlington, Mass.). 143p.

Monte Carlo calculations were performed to determine the back-scattering and the transmission of gamma rays having energies between 0.02 and 10.0 Mev from concrete. The radiation was assumed to be incident on a semi-infinite medium and on various slab thicknesses of 0.5, 1.0, 2.0, and 4.0 mfp at angles of $\cos \Theta_0 = 1.0, 0.75, 0.50, 0.25$, and 0.10. The case histories of 5000 photons were followed on the IBM 704 digital computer. The information obtained included: the characteristics of emergent photons, which were stored on magnetic tape; a routine that processes

these characteristics to give polar and azimuthal angular dose distribution; detailed results from the application of the processing routine to the parameters investigated. The computer program, the processing routine, and the results are appended. (auth)

28699 (RAS-38) EVALUATION OF THE INTERMEDIATE NEUTRON DOSE RATE IN RADIATION SURVEYS OF BIOLOGICAL SHIELDING. J. Shapiro (General Dynamics Corp. Electric Boat Div., Groton, Conn.). July 17, 1961. 22p.

Indium foils may be used to evaluate intermediate neutron dose rates in surveys of biological shields provided the neutron energy spectrum from indium resonance to the upper bound of the energy band under consideration is known. This spectrum can be specified fairly accurately for neutrons emerging through the typical biological shield, when the spectrum is determined primarily from scattering in hydrogen. Equations are presented for converting the activations of bare and cadmium covered indium foils to intermediate neutron dose rates. Theoretical considerations show that the relative contributions of the different energy regions to the neutron dose for fission source neutrons attenuated by 120 cm of water are 88% for fast neutrons, 5.5% for intermediate neutrons, and 6.5% for thermal neutrons. The fraction contributed by the intermediate neutrons increases as the hydrogen content is reduced. The method may be used to measure epithermal dose rates as low as 0.2 mrem per hour with simple G-M counters. The sensitivity could be increased appreciably with low background counters (1 to 2 counts per minute). (auth)

28700 SHIELDING MANNED SPACE VEHICLES FROM SPACE RADIATIONS. N. K. Ganguly and J. T. Lence (Astra Inc., Raleigh, N. C.). J. Brit. Interplanet. Soc., 18: 110-14(May-June 1961).

The known major radiations (including primary cosmic, trapped, and solar flare radiations) encountered outside the Earth's atmosphere are described. Interactions of primary cosmic radiation in the atmosphere are considered and primary cosmic radiation dose is estimated. An estimate is also made of doses accumulated in passing through the possible importance of the Rossi transition effect. Shielding requirements, possible materials and arrangements and difficulty of providing sufficient solar flare shielding are reviewed. (auth)

Theoretical Physics

28701 (LA-2560) MULTIPLE SCATTERING CORRECTIONS TO THE NUCLEAR OPTICAL POTENTIAL. Robert R. Johnston (Los Alamos Scientific Lab., N. Mex.). June 5, 1961. Contract W-7405-eng-36. 89p.

The elastic scattering of nuclear particles by nuclei may be described in terms of an equivalent two-body (optical) potential. Experiments indicate a discrepancy between the observed values of the optical potential and the theoretical values predicted by the simple first-order theory. The multiple scattering corrections to the first-order theoretical potential are calculated. The resulting second-order potential is evaluated, for two nuclear models, for incident pions and nucleons. It is found that these corrections bring the theoretical and experimental potentials into agreement. (auth)

28702 (LMSD-288254) A SELF-CONSISTENT FIELD THEORY OF QUANTUM ELECTRODYNAMICS. Mendel Sachs and Solomon L. Schwebel (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). May 1960. 25p. (PB-171533)

A self-consistent field theory of quantum electrodynamics was developed based on the postulate that the laws of nature must be described in terms of field variables which may be associated only with elementary interactions. Coupled with this postulate was a reinterpretation and reformulation of the Maxwell-Lorentz theory of electromagnetism. Quantum mechanics was interpreted as a statistical theory of elementary interactions. One consequence of this theory was the rejection of the photon as an elementary particle and its replacement by a state of the particle-antiparticle pair. An application of the theory to a system of identical particles revealed mathematical consequences identical to those obtained from the Pauli exclusion principle. A study of positronium revealed in detail the structure of the theory. Annihilation and creation processes of particle-antiparticle pairs were shown to be states of this two-particle system. (auth)

28703 (PIBMRI-936-61) EIGENWAVES ON A LATTICE OF SMALL SCATTERERS. Herbert Kurss (Brooklyn. Polytechnic Inst. Microwave Research Inst.). July 17, 1961. Contract AF18(600)-1505. 26p. (AFOSR-1140)

Previously, the quantum mechanical Bloch waves in a cubic crystal were analyzed by a cavity or structure constant approach by J. Korringa, W. Kohn, and N. Rostoker, et al. This method was reformulated to permit the analysis of electromagnetic Bloch waves in artificial dielectrics as well as electromagnetic surface waves on open periodic structures. It was found that a "lossless" scatterer embedded in a "lossless" medium can be characterized by a Hermitian matrix R. The lattice structure was then characterized by a "structure constant" matrix Γ which, in the eigenwave region, is also Hermitian. A dispersion relation for eigenwaves was obtained as the condition that the determinant of $R-\Gamma$ vanishes. (auth)

28704 (UCRL-Trans-681(L)) COLLECTIVE AND INDIVIDUAL DEGREES OF FREEDOM IN HELIUM II. W. Brenig. Translated by S. G. Brush (Mathematical Inst., Oxford) from Z. Physik, 144: 488-508(1956). 38p.

The Hamiltonian operator of a real Bose gas of N particles of mass m is transformed into "collective" and an "individual" parts. The collective excitations correspond to N longitudinal sound waves with a spectrum $\epsilon(k) = \hbar kc$, $k < k_D$ (c = velocity of sound, ck_D = Debye frequency). The individual spectrum is essentially that of an ideal Bose gas with 2N/3 particles with mass $m^* = 3m/2$, with excitations of momentum $\hbar k < \hbar k_D$ forbidden. The individual excitations are very similar to quantized rotons. The specific heat c_v of the whole system shows a discontinuity of a consequence of the Bose-Einstein condensation of individual excitations. Above the λ-point, $c_v \approx Nk$ in agreement with the experimental value for He. (auth)

28705 (UCRL-Trans-697) CLASSICAL GAUGE INVARIANCES OF QUANTIC ELECTRODYNAMICS. B. Jouvet. Translated for Univ. of California from Nuovo cimento (10), 20: 28-58(Apr. 1, 1961). 41p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 24477.

28706 STATIONARY FIELD WITH CYLINDRICAL SYMMETRY IN BORN-INFELD NON-LINEAR ELECTRODYNAMICS. J. Fernández Ferrer and E. de Rafael Gavaldá (Universidad, Barcelona). Anales real sóc. espãn. fís. y quím. (Madrid), Ser. A, 56: 273-80(Nov.-Dec. 1960). (In Spanish)

A solution of Born's nonlinear electrodynamical equations is given for the stationary case in a cylindrical symmetric field. The results are compared with those given by Maxwell's electrodynamics. (auth)

28707 ELEMENTARY INTERACTIONS IN SPACES WITH TORSION. Robert Finkelstein (Univ. of California, Los Angeles). Ann. Phys. (N. Y.), 15: 223-49(Aug. 1961).

Parallel transfer is generalized to allow for the existence of a local gauge group. In spaces with torsion such a group may be introduced in a natural way and physically interpreted as a generalization of the electromagnetic gauge group. It is possible to construct simple theories of this type which correctly represent the isospin symmetries of the known fields. According to the program here proposed the local connection of microspace is restricted by the symmetries of the observed fields; the dynamics is then determined by the curvature of space, just as in the known macroscopic limit. In the models here considered the discrete groups are not discussed and all conservation laws are exact. (auth)

28708 GENERAL RELATIONS CONCERNING MULTIPLY-PERIODIC EXCITATION OF NONLINEAR DYNAMICAL SYSTEMS. P. A. Sturrock (Stanford Univ., California). Ann. Phys. (N. Y.), 15: 250-65(Aug. 1961).

If a nonlinear dynamic system is in a state of steady multiply-periodic excitation with a number of incommensurable fundamental frequencies, there exist the same number of relations governing the transfer of energy in this system. General forms for these relations may be established by modifications of the theorem of the Poincaré invariant. These theorems enable one to associate a conservation relation with a closed (cyclic) family of dynamical systems; such a family may be formed by varying any one of the phase parameters which associate with the fundamental frequencies. The relations are first set up in a form appropriate to systems with a finite number of degrees of freedom. When applied to a purely reactive electrical network, these relations reduce to those derived by Manley and Rowe. The relations are next established in a form appropriate to the study of non-linear fields. The general relations are specialized for the following examples: nonlinear electromagnetic media; one-dimensional electron beam with electrostatic field; and unrestricted electron flow with electromagnetic field. These examples reproduce and extend relations established by Haus and Grau. (auth)

28709 A GENERALIZED PERTURBATION THEORY FOR QUANTUM MECHANICAL MANY-BODY PROBLEMS. H. Primas (Technische Hochschule, Zürich). Helv. Phys. Acta, 34: 331-51(1961). (In German)

A generalized form of a perturbation theory for a (nonrelativistic) quantum mechanical many-body Hamiltonian is given that can be useful for problems of quantum chemistry and other problems with a moderate number of particles. A modification of Watson's t-operator allows a perturbational development of a many body problem in terms of simpler subproblems. Some examples of such cluster approximations are given. The whole theory is formulated in operator form, no recourse is made to a representation in terms of state vectors and there are no assumptions about the degeneracy of the Hamiltonian. The given approximations to the level shift transformation are both unitary and Lie functions in every order of the development. Every step of the calculation can be done in the domain of a Lie algebra and it is recommended that full advantage be taken of this fact in practical calculations. The use of the diagram technique is avoided and there are no explicit partial summations of the perturbation series, but similar results are gained by the systematic use of the unitary conditions, of the Lie character, and of a modified t-operator. (auth)

28710 NON-LINEAR CORRECTIONS TO THE FREQUENCY OF PHASE OSCILLATIONS. S. A. Kheifets (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 12: No. 6, 121-2(1959). (In Russian)

The function of unattenuated phase oscillations with nonlinearity was investigated. In order to obtain the frequency correction, a non-linear substitution method was used. Results indicate that the quadratic non-linearity plays a greater role than the cubic term; on the other hand, in previous literature data the quadratic non-linearity in general was not considered. (TTT)

28711 APPLICATIONS OF NON-LINEAR FIELD MERGING METHODS. D. F. Kurdgelaidze (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 1, 3-16(1961). (In Russian)

The method of non-linear field merging is applied in determining the constant of nucleon bonding with a scalar meson field $\alpha_{g_0} = g_0^2/\hbar$ ($\hbar$ is Planck's constant divided into 2π) and for deriving the forces inducing multiple meson production. An equation was developed for the meson-gas state with non-linear interaction. (tr-auth)

28712 ON THE THEORY OF STRATIFICATION OF A NON-IDEAL FERMI AND BOSE GAS MIXTURE. V. G. Zelinskii (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 1, 54-62(1961). (In Russian)

Stratification of liquid helium isotopes near absolute zero was studied on the basis of a mixed non-ideal Fermi and Bose gas. Certain qualitative equilibrium phases are studied within the first perturbation theory approximation. The effect is determined by the particle interactions which must satisfy given conditions. It is shown that at temperatures sufficiently removed from the initial demixing, the improvished component particles may be considered as a Boltzmann gas. A complete separation of components is reached at absolute zero. (R.V.J.)

28713 A ONE-DIMENSIONAL FIELD THEORY WITH DEGENERATE VACUUM. K. Baumann and R. Sexl (Universität, Vienna). Nuclear Phys., 26: 117-25(1961). (In English)

A one-dimensional field theory is considered corresponding to the continuous limit of a spin chain. The vacuum degeneracy of this theory is explored. Besides, it is shown that the theory can equivalently be formulated in terms of an interacting Fermi field or of a Bose field without interaction. Finally, a theory is briefly discussed which can either be treated as an interacting Bose field or as a free Fermi field. (auth)

28714 PAIRING AND QUADRUPOLE FORCES IN A TWO-DIMENSIONAL SOLUBLE MODEL. H. J. Lipkin (Weizmann Inst. of Science, Rehovoth, Israel). Nuclear Phys., 26: 147-60(1961). (In English)

The model treated is a system of particles moving in a two-dimensional harmonic oscillator potential with two-body pairing and quadrupole forces mixing states within a single major shell. A simple representation is found in which the Hamiltonian is exactly diagonal. An "energy gap" is obtained in the limit of pure pairing forces and rotational spectra in the limit of pure quadrupole forces. In the intermediate region the spectrum varies from energy gap to rotational as the number of particles is increased. The effective moment of inertia of the rotational band is unaffected by the pairing force, remaining constant at the value for a pure quadrupole force. The model is also treated by replacing the quadrupole force by a self-consistent deformed field and the moment of inertia is calculated using the cranking model. The results agree with the exact solution. Implications of the model for more realistic cases are discussed. (auth)

28715 ENERGY LOSSES IN A MANY-BODY SYSTEM. Stanley Engelsberg (Univ. of Illinois, Urbana). Phys. Rev., 123: 1130-7(Aug. 15, 1961).

The energy loss problem is formulated in such a way as to include all losses simultaneously. The lifetime and energy losses of a particle in a well-defined single-particle state with small transition probability are found to be related to the self-energy operator. As an illustration of the application of the relation obtained, a derivation of the Bethe sum rule and the Čerenkov losses is given for a particle incident on a many-body system. (auth)

28716 DYNAMICAL THEORY FOR STRONG INTERACTIONS AT LOW MOMENTUM TRANSFERS BUT ARBITRARY ENERGIES. Geoffrey F. Chew and Steven C. Frautschi (Univ. of California, Berkeley). Phys. Rev., 123: 1478-86(Aug. 15, 1961). (UCRL-9510)

Starting from the Mandelstam representation, it is argued on physical grouns that "strips" along the boundaries of the double spectral regions are likely to control the physical elastic scattering amplitude for arbitrarily high energies at small momentum transfers. Pion-pion scattering is used as an illustration to show how the double spectral functions in the nearest strip regions may be calculated, and an attempt is made to formulate an approximate but "complete" set of dynamical equations. The asymptotic behavior of the solutions of these equations is discussed, and it is shown that if the total cross section is to approach a constant at large energies then at low energy the S-dominant $\pi\pi$ solution is inadmissible. A principle of "maximum strength" for strong interactions is proposed, and it is argued that such a principle will allow large low-energy phase shifts only for $l \leq l_{max}$, where $l_{max} \sim 1$. (auth)

28717 HYPERVIRIAL THEOREMS FOR VARIATIONAL WAVE FUNCTIONS. Saul T. Epstein (Univ. of Nebraska. Lincoln) and Joseph O. Hirschfelder. Phys. Rev., 123: 1495-1502(Aug. 15, 1961).

It is shown that a sufficient condition for an optimal energy variational wave function ψ_0 to satisfy the hypervirial relation $(\psi_0[H,W]\psi_0) = 0$ is for the trial function ψ to admit variations of the form $\partial\psi/\partial a = (i/h)W\psi$. Here H is the Hamiltonian, W is a Hermitian operator, and a is a variational parameter. Explicit forms of such trial functions are exhibited for several W's. The case in which W generates a point transformation of the coordinates is discussed in detail. Conditions are given for the existence of simultaneous hypervirial theorems. (auth)

28718 EVOLUTION OF A QUASI-STATIONARY STATE. Rolf G. Winter (Pennsylvania State Univ., University Park). Phys. Rev., 123: 1503-7(Aug. 15, 1961).

To elucidate the time development of quasi-stationary states, a simple barrier penetration problem has been studied. Both approximate expressions and numerical results for some parameters were obtained for the decay rate. First, irregular oscillations occur for a short time. Second, the exponential region follows. Third, further oscillations occur during which the decay rate dips to negative values, so that the probability of finding the undecayed system increases briefly at several times. Fourth and finally, the decay rate decreases like an inverse power of the time. (auth)

28719 FURTHER CONSIDERATIONS ON ELECTROMAGNETIC POTENTIALS IN THE QUANTUM THEORY. Y. Aharonov (Brandeis Univ., Waltham, Mass.) and D. Bohm. Phys. Rev., 123: 1511-24(Aug. 15, 1961).

The significance of potentials in the quantum theory is discussed. The treatment is extended to include the sources of potentials, and it is shown that when this is done, the same results are obtained as those of a preceding paper, in which the potential was taken to be a specified function of space and time. The importance of the potential in the expression of the local character of the interaction of charged particles and the electromagnetic field is thus brought out. (auth)

28720 ON THE APPROACH TO EQUILIBRIUM IN QUANTUM SYSTEMS. P. Résibois (Université Libre, Brussels). Physica, 27: 541-70(June 1961). (In English)

The formal analogy between the classical Liouville equations and the quantum mechanical von Neumann equations permits use of the classical results in the study of the asymptotic behavior of a quantum system with finite particle density. The technique of diagrams used in the classical case is generalized to permit the classification of the different contributions to the formal solution of the quantum system. Equations are obtained for the asymptotic evolution of the density matrix, and it is shown that these equations have as a stationary solution the canonical equilibrium distribution. The theory is valid for a large category of initial states. The requirements for validity are that at t = 0 the reduced properties of the system be finite, and that the spatial correlations between particles have finite range. (T.F.H.)

28721 ON THE CANONICAL DISTRIBUTION IN QUANTUM STATISTICAL MECHANICS. J. Van der Linden and P. Mazur (Universiteit, Leiden). Physica, 27: 609-28(June 1961).

It is shown, within the framework of quantum statistical mechanics, that the canonical ensemble representing a system in thermal contact with a heat bath may be obtained, from the microcanonical ensemble representing an energetically insulated system. Use is made in the derivation, which is analogous to the derivation for the classical case, of the phase space representation of quantum statistical mechanics (Wigner distribution functions). (auth)

28722 QUANTUM STATISTICAL ANALOGUE OF WARD'S IDENTITY. Keiji Watanabe (Univ. of Tokyo), Osamu Kamei, and Hiroshi Ezawa. Progr. Theoret. Phys. (Kyoto), 25: 735-42(May 1961). (In English)

Considering the quantum statistical electrodynamics, an identity which corresponds to Ward's in quantum electrodynamics is proven. In the course of the discussion, an emphasis is put on the periodicity properties of the functions which appear therein. (auth)

28723 ON AN EXTENSION OF THE MATHEMATICAL FRAMEWORK OF THE QUANTUM THEORY. Hitoshi Wakita (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 25: 743-52(May 1961). (In English)

Extending the usual framework of the quantum theory, a new mathematical framework is presented. The most essential character of the usual theory is preserved in the new theory, that is, the set of physical quantities can be represented by an operator algebra in a separable Hilbert space. The new theory, on the other hand, rigorously treats the interaction Hamiltonians, which cannot be treated in the usual framework. In the new framework there are always solutions of the Schrödinger equation for any Hamiltonian. However, the most serious defect of the theory is in the fact that there is no guarantee of the uniqueness of solutions. (auth)

28724 EXACT TREATMENT OF THE BOUND STATE PROBLEMS IN THE NON-RELATIVISTIC QUANTUM FIELD THEORY. Nobumichi Mugibayashi (Kobe Univ., Japan). Progr. Theoret. Phys. (Kyoto), 25: 803-21(May 1961). (In English)

An exact equation for the bound state of nucleons in the static neutral scalar model is obtained by using the field equation for Heisenberg operator and the method of canonical transformation. The formulation of the eigenvalue problem is completed by the analyticity consideration. In particular, a boundary condition at $\tau = 0$ ($-i\tau$ being the "negative imaginary" relative time) turns out that the derivative of the "wave function" with respect to τ must be zero at $\tau = 0$. The abnormal solutions exist in this case as well as in the latter approximation, but there is difference in nature between them for the zero meson mass case. The appearance of abnormal solutions is mainly due to the structure of the fundamental equation itself. This is demonstrated by handling a first order equation for the static neutral scalar model and the Bethe-Salpeter equation for the Lee model, in both cases of which the abnormal solutions do not appear. (auth)

28725 ON THE AXIAL VECTOR CURRENT CONSERVATION. Yasuhisa Katayama (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 827-41(May 1961). (In English)

The conservation law of axial vector in β-decay is investigated in the system of the pion-nucleon interacting through ps(ps) and ps(pv) couplings. The system necessarily contains other types of bosons beside the pion field in order to realize the conservation law in a limit of zero pion mass. Three new bosons, scalar (iso-scalar), vector (iso-vector), and pseudo-vector (iso-vector), are at least necessary. The meaning of their coexistence is discussed from the theory of the composite model. (auth)

28726 INVARIANCE OF PLANCK'S CONSTANT IN REVISED RELATIVITY OF J. PALACIOS. A. H. Klotz (Rutherford Coll. of Tech., Newcastle-upon-Tyne, Eng.). Progr. Theoret. Phys. (Kyoto), 25: 860-1(May 1961). (In English)

A revised theory of relativity was proposed by J. Palacios, which avoids the clock paradox of special relativity by regarding a reference system A to be in a state of absolute rest. It was stated that the Planck constant $\underline{h}$ would have to undergo a transformation. It is now shown that the noninvariance of Planck's constant is no longer required, even if Palacios' transformations are correct. (L.N.N.)

28727 QUANTUM THEORY OF SPIN DIFFUSION. Hazime Mori and Kyozi Kawasaki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 866-7(May 1961). (In English)

A general formulation of the macroscopic equations for the three components of the magnetization density M(R) is made. A quantum theory of transport is used. (L.N.N.)

28728 DISPERSION RELATIONS AND HIGH ENERGY LIMITS IN QUANTUM FIELD THEORY. III. NECESSARY CONDITION FOR EXISTENCE OF SOLUTIONS OF DISPERSION RELATIONS. Seiya Aramaki (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 25: 981-8(June 1961). (In English)

It is shown that pion-nucleon forward scattering amplitude must have zeros on the complex energy plane. This is derived by imposing the necessary condition for the existence of solutions on the dispersion relation for pion-nucleon forward scattering. By extending this result to the case of pion propagator, discussions against perturbation theory are made. Finally by applying this necessary condition to the dispersion relation given by Goldberger, it is concluded that either the pion-nucleon total corss sections increase at very high energies or Goldberger's dispersion relation has no solution. (auth)

28729 A RELATIVISTIC FIELD THEORY MODEL WHICH ADMITS AN EXACT SOLUTION. D. A. Kirzhnits and S. A. Smolyanskii (Lebedev Inst. [of Physics, Moscow]). Zhur. Eksptl'. i Teoret. Fiz., 41: 205-8(July 1961). (In Russian)

A model which is a relativistic extension of the Ruijgrok-van Hove and Lee model and which does not involve the difficulties inherent in the latter model is examined. (auth)

28730 A GAUGE INVARIANT FORMULATION OF NEUTRAL VECTOR FIELD THEORY. V. I. Ogievetskii and I. V. Polubarinov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 247-55 (July 1961). (In Russian)

It is demonstrated that zero mass neutral vector field theory can be formulated in a gauge invariant from without the introduction of auxiliary fields. The physical meaning of gauge invariance in such a theory is trivial: the zero spin quanta described by the 4-vector A_μ do not interact with anything. Only quanta with a spin 1 can interact. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

28731 (AE-57) HETEROGENEOUS TWO-GROUP DIFFUSION THEORY FOR A FINITE CYLINDRICAL REACTOR. Alf Jonsson and Göran Näslund (Aktiebolaget Atomenergi, Stockholm). 1961. 22p.

The source and sink method given by Feinberg and Galanin was extended to a finite cylindrical reactor. A machine program calculating the criticality constant, thermal utilization, and the relative number of thermal absorptions in fuel rods was developed for the Ferranti-Mercury Computer. (auth)

28732 (ATL-A-109(Rev.1)) TECHNICAL FEASIBILITY AND ECONOMIC POTENTIAL OF THE VARIABLE MODERATOR REACTOR. Final Report. (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Dec. 15, 1960. Contract AT(04-3)-250. 290p.

The technical feasibility and economic potential of the Variable Moderator Reactor (VMR) is discussed. To carry out the parametric survey and detailed design analysis, a reference power level of approximately 20,000 kw(e) was selected. No important technical problems were discovered that would prevent successful operation of the VMR. The VMR was found to be economically more attractive than a comparable conventional boiling water reactor utilizing control rods in the small and medium power ranges. Based on the analysis of the design, the VMR appeared to be attractive for remote and critical power applications where low maintenance and minimum "down" time are required, because of the small size of the reactor and the expected high degree of operating reliability. The physics analytical model showed good agreement with most of the macroscopic effects of the critical experiment data and was adequate to place a high degree of reliability on the reactor physics calculations employed in the development of reactor design. The VMR system can be designed to operate in a stable manner under steady-state conditions with either a positive or negative steam void reactivity coefficient. However, economics indicates the desirability of a design with a negative void coefficient. Comparison of VMR costs with conventional BWR costs, design data, methods of selection of some major reactor parameters, technical feasibility, and critical experiments are discussed. Mechanical and system drawings are presented. (M.C.G.)

28733 (CEND-85) THE DEVELOPMENT AND TESTING OF THE UO_2 FUEL ELEMENT SYSTEM. Progress Report for Period January 1, 1960—March 31, 1960. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Contract AT(30-1)-2379. 47p. (NYO-9007)

A pneumatic vibratory compaction machine was designed, constructed, and placed in operation. A study was initiated to determine the feasibility of reaching densities of 90% of theoretical. Eight tubes filled with MgO, used as a substitute for UO_2, were reduced in cross sections by the Rock Rite process. Initial as-packed density in all specimens was about 65% of theoretical, and final densities ranged from 75 to 90%. Reductions on the various specimens ranged from 20 to 60%. No cladding failures occurred during reduction. Simple welds, one spacer to one rod, were successful in that welds can be made which penetrate only about 50% of the clad wall. Work hardened tubing was subjected to 700°F steam for periods up to 123 days. Tensile testing of the specimens showed that no annealing occurred. (auth)

28734 (CRT-1033) CORRECTION FOR NON-ZERO TIME STEP IN THE NUMERICAL SIMULATION OF SPATIAL OSCILLATIONS OF XENON IN A NUCLEAR REACTOR. B. Davison and H. H. Clayton (Atomic Energy of Canada Ltd., Chalk River, Ont.). July 1961. 17p. (AECL-1292)

In order to reduce computation time, a long time step could be assumed in the numerical integrations involved in investigations of xenon instabilities in large high-flux reactors. The question of error introduced by this assumption is examined in the case of the linear approximation of the nonlinear problem. It is shown that, if corrections in the perturbation procedure of order higher than the first are negligible, there exists a simple relationship between the true time constant of any instability mode and the time constant calculated with the aid of a non-zero time step. (D.L.C.)

28735 (DP-598) R-3/ADAM LATTICE BUCKLING MEASUREMENTS IN THE PROCESS DEVELOPMENT PILE. William E. Graves (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). July 1961. Contract AT(07-2)-1. 16p.

As part of a Swedish—U. S. exchange program on D_2O-moderated power reactors, measurements were made in the Process Development Pile to determine the bucklings of two lattices utilizing fuel assemblies intended for use in the Swedish R-3/Adam reactor. Refinements in critical substitution techniques made it possible to perform precise buckling measurements from a minimum number of assemblies. These experiments supplemented less precise but more extensive buckling measurements made in the Savannah River Laboratory exponential facilities. (auth)

28736 (HW-66227) MODIFICATION STUDY—DR-1 LOOP. Interim Report. F. W. Van Wormer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 28, 1960. Contract AT(45-1)-1350. 12p.

Engineering studies are being made to determine the possibility of operating the DR-1 Loop with the continuous and intentional release of fission products from test fuel elements in the loop. A study was made to analytically characterize the nature and problems of fission product release. The results of these analyses are summarized according to general classifications, and their radioactivity contribution, normalized to each released curie of Xe^{133}, is estimated. It was concluded that the existing loop is not suitable for such operation from the standpoint of radiological safety of personnel. The modifications proposed for the loop are outlined. (auth)

28737 (IDO-16683) PROCESS WATER FISSION PRODUCT ACTIVITY FROM MTR FUEL ASSEMBLIES. D. R. deBoisblanc, C. F. Leyse, and M. H. Bartz (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 26, 1954. Changed from OFFICIAL USE ONLY July 12, 1961. Contract AT(10-1)-205. 13p. (MTRL-54-62)

Observations made following the recent fission break in the MTR are described briefly. It was determined that the source of the fission product activity is the outer plates of MTR fuel assemblies. A tabulation is given of those fuel assemblies showing visible defects. (auth)

28738 (NAA-SR-5858) RADIAL FLUX FLATTENING IN THE ORGANIC MODERATED REACTOR CRITICAL ASSEMBLY BY VARIABLE FUEL-TO-MODERATOR RATIO.

R. A. Blaine and J. L. Watts (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 15, 1961. Contract AT(11-1)-GEN-8. 30p.

Calculations are carried out for a flux flattening experiment in the Organic Moderated Reactor critical assembly. It is proposed that the flux be flattened by varying the numbers of fuel plates per element to achieve variable fuel-to-moderator ratio. It is concluded that a reduction of the peak-to-average ratio from 1.69 to 1.17 can be achieved by this method; and that the power distribution is made more uneven by this method, so that variable fuel-to-moderator ratio is probably not desirable for full-scale power reactors. (auth)

28739 (NAA-SR-Memo-3485) CALCULATED THERMAL FLUX DISTRIBUTION IN AND AROUND SRE INPILE POISON RING TEST. R. J. Doyas (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 23, 1959. 13p.

The neutron flux distribution around the Sodium Reactor Experiment inpile poison ring test was calculated, using the PDQ 2-dimensional neutron diffusion equation IBM-704 code, for an axial and radial case. Figures are shown of the calculated axial flux distribution and the x-y profile of the region used for the horizontal flux distribution. (M.C.G.)

28740 (NARF-61-20T) MODERATOR AND SHIELD WATER GRAPHIC CONTROL PANEL FOR THE NARF REACTORS. R. G. Deering and B. W. Landborg (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Aug. 1, 1961. Contract AF33(600)-38946. 16p. (MR-N-276)

The design, fabrication, and operation of a graphic-control and function-display panel for the reactor moderator and shield water systems of the Nuclear Aerospace Research Facility (NARF) are described. The panel logically presents all physical and dynamic features pertaining to the transfer and storage of moderator and shield water in the NARF reactor complex. This panel features the use of electroluminescent lighting for schematic flow representation. (auth)

28741 (NDA-2147-7) STABILITY STUDIES ON FAST REACTORS WITH DELAYED REACTIVITY COEFFICIENTS. J. Agresta (United Nuclear Corp., White Plains, N. Y.). Aug. 15, 1961. Contract AT(30-1)-2303(XIII). 51p.

A systematic study was made on the effects of power coefficients of the types usually found in fast reactors on reactor stability. Both finite and infinite resonances in the transfer function giving the power response to reactivity oscillations are considered. The following coefficient cases were treated: delayed negative coefficient of the conduction or convection type, either alone or in combination with a prompt coefficient, and a combination of both delayed-convection and delayed-conduction type coefficients. Formulas are given for testing unconditional stability of systems. (D.L.C.)

28742 (NP-10560) THE STABILITY OF HOMOGENEOUS NUCLEAR REACTORS WITH NON-LINEAR REACTIVITY DEPENDENCE ON TEMPERATURE. Henri B. Smets (European Nuclear Energy Agency, Paris). 1961. 18p.

Presented at the European Atomic Energy Society Symposium on Safety, Control and Instrumentation of Zero Energy and Sub-Critical Assemblies, Bournemouth, June 28-30, 1961.

The stability and instability properties of homogeneous nuclear reactors with a single temperature coefficient of reactivity which is temperature dependent were studied by means of Liapounoff's Second Method. The special case of a temperature coefficient linearly dependent on temperature was solved completely and it is shown that all solutions are bounded and tend asymptotically to a constant if the reactivity is negative for very large values of temperature. In some conditions, the reactor has two stable equilibrium points (bistable). (auth)

28743 (NP-10610) FAST REACTOR DESIGN. A BIBLIOGRAPHY. Technical Report 61-3. Tibor Vincze, comp. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1961. 92p.

Five hundred and fifty five references on fast reactors are presented. The bibliography covers reports, journal articles, books, U. S. and British patents, and conferences published from 1945 to 1960. Entries of reports and periodicals are arranged chronologically by year, and within the chronological sections the arrangement is alphabetical by title. The other sections were arranged by title. Author and subject indexes are included. (M.C.G.)

28744 (NYO-2692) NUCLEAR FUEL RESEARCH FUEL CYCLE DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT, JANUARY 1—MARCH 31, 1961. (Olin Mathieson Chemical Corp., New Haven). May 17, 1961. Contract AT(30-1)-2374. 35p.

The laboratory scale development phase of a process for the fabrication of UO_2 pellets based on low temperature sintering in nitrogen was completed. Work was initiated on the preparation and encapsulation of enriched UO_2 pellets for irradiation testing. Further investigation of the effect of fluoride additions on the sintering behavior of UO_2 confirmed that oxidation-reduction cycling restored the oxide sinterability lost as a result of fluoridation. A series of sintering experiments were performed with the objective of producing high density UO_2 pellets in excess of 98% theoretical density. Modification of the oxidation-reduction activation treatment could produce such densities. It also appeared that sintering temperatures as low as 1000°C can be used to prepare pellets of the design density of 95% theoretical density. The propane reaction was further studied to develop techniques for preparing uranium carbide powder to a given total carbon specification. A comparison was made between the use of unreacted UO_2—graphite and reacted UO_2—graphite charges to the arc skull furnace. The reacted charge gave the best results. The determination of the physical properties of uranium carbide as a function of composition and fabricational variables was initiated. The thermal expansion of cast 4.85 wt.% C uranium carbide was determined at 12.55×10^{-6} in./in./°C. (auth)

28745 (ORNL-3168) A MODEL FOR FISSION-GAS RELEASE FROM POROUS FUELS IN LOW-PERMEABILITY CONTAINERS. John W. Prados (Oak Ridge National Lab., Tenn.). Aug. 25, 1961. Contract W-7405-eng-26. 15p.

A simple methematical model was developed to describe the steady-state release rate of gaseous fission products from porous ceramic fuels in low-permeability containers. The resulting equations are used to analyze experimental release-rate results obtained from a UC_2-fueled graphite fuel body enclosed in a low-permeability impregnated graphite container. The relative release rates of the fission-product species Kr^{85m}, Kr^{88}, and Xe^{133} were predicted with reasonable success. Absolute-rate predictions were not possible due to lack of information on true permeability and porosity profiles in the graphite container. (auth)

28746 (ORO-460) FUEL-BEARING FIBERGLAS IN ALUMINUM BASE FUEL ELEMENTS. Seventh Quarterly Report, Covering April 1, 1961 to June 30, 1961. R. H.

Baskey (Clevite Corp. Mechanical Research Div., Cleveland). July 20, 1961. Contract AT(40-1)-2557. 10p.

Irradiation specimens (tensile and bend) were machined and shipped to Battelle. These specimens were unclad and clad. The core material was Al-coated, enriched U-bearing fiberglas with a loading of 10.53 ± 0.2 g of U^{235} per plate. They will be preirradiation examined, encapsulated, and then irradiated in the MTR. Plates containing Al-coated, U-bearing fiberglas core sections can be clad with two types of material, i.e., alclad 5154 or alclad fiberglas-reinforced Al. The alclad fiberglas-reinforced Al must overlap the core edges by at least $\frac{1}{32}$-inch. Plates containing Al-coated depleted U-bearing fiberglas core sections were formed with a 5.50-inch radius. Alclad 5154 plates can be formed at room temperature. Alclad fiberglas-reinforced Al plates must be formed at 350 to 500F. (auth)

28747 (ORO-463) FUEL CYCLE DEVELOPMENT PROGRAM MONTHLY NEWSLETTER, MAY 1961. M. A. Bobal (National Carbon Co., Fostoria, Ohio). July 24, 1961. Contract AT(40-1)-2560. 5p.

In dispersing 5 wt % UO_2 shot in TS-160 mix, the UO_2 variation per cc was found to be slightly less for pellets from a blend with an intensive post-mix than for those from a blend with a tumbling post-mix. The variation of UC_2 content of carbon-coated UC_2 shot dispersed in TS-160 was measured. The U dispersion in a hand dispersion of UO_2 shot of 460-μ diameter in TS-160 was also measured. The development of a high-temperature nigration furnace is described. A molding experiment on a blend of TS-160 and 20 wt % pyrolytic carbon-coated UC_2 indicates that molding pressures above 6 Tsi cracks the coating. (D.L.C.)

28748 (UCRL-5625(Rev.)) THE NUCLEAR RAMJET PROPULSION SYSTEM. Theodore C. Merkle (California. Univ., Livermore. Lawrence Radiation Lab.). May 15, 1961. Contract W-7405-eng-48. 21p.

A review of technology related to nuclear ramjets is presented. Problems for research are pointed out in the area of minimization of the yield requirement in ramjet materials because of the non-yielding characteristics of oxides and carbides selected for these uses. Other problems include large neutron and gamma fluxes, reactor control, and waste disposal. General descriptions of the Tory reactors are included. (J.R.D.)

28749 (AEC-tr-4402) ATOMIC REACTORS IN FRANCE. (Les Piles Atomiques en France). J. Yvon. Translated from J. phys. radium 18, 545-51(1957). 10p.

Also issued in French as report CEA-747.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 3285.

28750 (AEC-tr-4504) REACTOR G 1: FLUX CHARTS IN THE FLAT REACTOR. J. P. Genthon (France. Commissariat a l'Energie Atomique, Paris). Translated from CEA-Note-222, Oct. 1957. 26p.

A study of the experimental flux distribution for various conditions in the Marcoule Reactor (G-1) was conducted. The resulting distributions are given by points. The flux at each point is the result of irradiation and counting followed by plotting the count. All flux density measurements are relative. (J.R.D.)

28751 (AEC-tr-4774) MOLTEN SALTS IN NUCLEAR TECHNOLOGY. H. U. Woelk. Translated by A. R. Saunders and H. H. Stone for Oak Ridge National Lab. from Chem.-Ingr.-Tech., 32: 765-73(1960). 24p.

Molten salts can be applied in nuclear technology as solvents or extraction media in fuel processing, as moderators and solvents for fissionable materials in homogeneous power reactors, and as high-temperature coolants for reactors. The current status of these applications and some of the resulting chemical problems are discussed. (auth)

28752 VIEWPOINTS ON DEVELOPMENT OF REACTOR INSTRUMENTATION AT AEG. Lorenz Beug and Eberhard Steudel. AEG Mitt., 50: 293-5(Aug.-Sept. 1960). (In German)

With the development of reactor technology, the viewpoint for development of control and safety instruments has changed. A discussion is presented of trends at AEG for improvement of detectors, amplifiers, and counters. (T.R.H.)

28753 DIRECT CURRENT AMPLIFIERS IN REACTOR INSTRUMENTATION. Gerhard Aulich and Werner Nottelmann. A E G Mitt., 50: 296-300(Aug.-Sept. 1960). (In German)

For measurement and control of neutron flux in reactors, a d-c amplifier and a neutron-sensitive ionization chamber are used. A linear and a logarithmic d-c amplifier are described along with a period amplifier. Circuits and performance data are given. (T.R.H.)

28754 INSTRUMENTATION OF THE DIDO REACTOR IN JÜLICH. Elmar Schrüfer. A E G Mitt., 50: 304-12(Aug.-Sept. 1960). (In German)

Extensive instrumentation was required for the DIDO research reactor built near Julich. The most important measurement problems and the apparatus needed for their solution are discussed. The main measurement sites have limiting value contacts which are linked thru electrical connections to the control apparatus so that the reactor, when dangerous operating values exist, shuts itself down. In addition, the reactor thru interlocking connections is protected against operator errors. (tr-auth)

28755 INSTRUMENTATION OF THE ARGONAUT-TYPE TEST REACTOR PR-10 OF THE AEG. Gerhard Aulich. A E G Mitt., 50: 312-16(Aug.-Sept. 1960). (In German)

A survey is given of the nuclear instrumentation of the Argonaut-type PR-10 test reactor. The startup channel and the area monitoring channel are described. The safety system of the reactor and the startup apparatus are detailed. (tr-auth)

28756 THE STATISTICAL r-METHOD OF MEASURING THE KINETIC PARAMETERS OF A REACTOR. A. I. Mogil'ner and V. G. Zolotukhin. Atomnaya Energ., 10: 377-9(Apr. 1961). (In Russian)

The mean life of prompt neutrons, the constant connecting neutron detectors with K_{eff} units, and the absolute station capacity were determined using one of the thermal subcritical lattices containing enriched (up to 75% U^{235}) uranium. The measurements were based on a previously described r_0 method and the relations $\Psi(at) = Z\varphi(at)$; $Z\ [\epsilon\nu(\nu-1)K_r^2/(1-K_r)^2\nu^{-2}]$; $\varphi(at) = 1-(1-e^{-at}/at)$. The scheme of the detector and the relation Ψ as a function of time t for a = 139.8 sec^{-1}, Z = 0.806 are plotted as well as the relation a = 1 − Kp/l as a function of count rate. Assuming that $\beta_{eff} = 0.007$, then the mean life of prompt neutrons is l = (0.82 ± 0.025) × 10^{-4} sec, which is in good agreement with two-group calculations (0.8 × 10^{-4} sec) and l = 0.87 × 10^{-4} sec obtained from reactor noise frequency analysis. (R.V.J.)

28757 DISTRIBUTION OF THE NUMBER OF COUNTS RECORDED BY A NEUTRON DETECTOR PLACED IN A REACTOR. V. G. Zolotukhin and A. I. Mogil'ner. Atomnaya Energ., 10: 379-80(Apr. 1961). (In Russian)

The distribution of counts recorded by a neutron detector

placed in a subcritical reactor differs from the Poisson law due to genetically connected fissions. The mean number is not uniform and depends on the number recorded in the preceding time interval. The Rossi alpha method for measuring reactor kinetic parameters is based on the above factors. It is postulated that the Poisson law is a maximum case of negative-binomial distribution at $\psi \rightarrow 0$. The tabulated results of a χ^2 application to negative-binomial distribution are in good agreement with experimental data. Measurements of ψ allow determinations of mean neutron life and reactor absolute capacity and control calculations in K_{eff} units. (R.V.J.)

28758 DENSITY OF A WATER–STEAM MIXTURE HEATED THROUGHOUT ITS BULK. V. K. Zavoiskii. Atomnaya Energ., 10: 381(Apr. 1961). (In Russian)

The relation between moderator density and reactor power is found for a small boiling reactor in which heating is evenly distributed throughout and the vapor centers are in the lower active zone. (R.V.J.)

28759 USE OF A MONOCHROMATOR TO MEASURE THE THERMAL NEUTRON SPECTRUM OF A RESEARCH REACTOR. Yu. Yu. Glazkov, B. G. Dubovskii, F. M. Kuznetsov, V. A. Semenov, and Fang P'eng. Atomnaya Energ., 10: 381-3(Apr. 1961). (In Russian)

A uranium-graphite subcritical assembly was used in studies of optimum diameter. A special monochromator designed for measuring thermal neutron spectra in small reactors was used to monitor the number of neutrons. The neutron temperature as function of the number of channels with 1.2% enriched uranium was plotted. Neutron distribution spectra for the lattices of various sizes with 2% enriched uranium are shown. The equivalent radius of a 37-cell assembly is 68 cm, the moderating distance $\sqrt{\tau} = 17$ cm, and the diffusion length L = 14 cm. Assuming that the neutron spectrum in the reactor does not differ greatly from Maxwellian, the order of accuracy of the effective neutron temperature is ~4%. (R.V.J.)

28760 THERMAL STRENGTH PROBLEMS IN REACTOR CONSTRUCTION. Ya. B. Fridman, N. D. Sobolev, S. V. Borisov, V. I. Egorov, V. P. Konoplenko, E. M. Morozov, L. A. Shapovalov, and B. F. Shorr. Atomnaya Energ., 10: 606-19(June 1961). (In Russian)

The structural materials used in reactors must fulfill a number of mechanical, chemical, nuclear, and thermal properties. Difficult stress and deformation problems arise from the temperature variations to which the system is subjected, resulting in loss of strength or in breakage. Fracture may be caused by either sudden or gradual temperature changes. Different criteria prevail for the various parts of the system: the deformation of the vessel material must be kept below 1% while in the cladding material it may reach several percent. The time factor plays a great role in the crack formation. Four special cases may be distinguished for cracks of both thermal and mechanical origin: mechanical or thermal shock, short-time static loading, long-time static loading, and fatigue phenomena from repeated mechanical action. Stress release by heat treatment and the elastic problems of unevenly loaded systems are also discussed. Micromechanical tests were found to be useful for determining the behavior of materials under induced stresses at temperatures up to the 1400-1500°C range. (28 references). (TTT)

28761 STUDY OF THE PHYSICAL CHARACTERISTICS OF A URANIUM–GRAPHITE REACTOR BY MEANS OF A SUBCRITICAL INSERT. Yu. Yu. Glazkov, L. A. Geraseva, B. G. Dubovskiĭ, A. K. Krasin, I. M. Kisil, F. M. Kuznetsov, Yu. M. Serebrennikov, V. P. Shelud'ko, V. N. Sharapov, and Fang Peng. Atomnaya Energ., 11: 5-11(July 1961). (In Russian)

The feasibility of using a subcritical insert for determining the value of the physical variables of interest to the reactor designers of a U-graphite lattice has been demonstrated in a series of experiments performed at the beginning of 1958, eliminating the necessity of constructing expensive assemblies. The insert representing a portion of the reactor studied, consisted of a natural U-graphite lattice, mocking up the Beloyarsk type reactor. It was placed in the core of a 0-power U-graphite system containing U fuel slugs enriched to 2%. The resonance escape probability in U^{238}, the fast neutron multiplication factor, the thermal neutron flux distribution and the cadmium ratio were thus measured. The dimensions of the insert depend greatly on the difference between the characteristics of the reactor studied and those of the reactor used for the tests. In some cases the dimensions may be smaller than required for obtaining a similar neutron spectrum in the new system. (TTT)

28762 THE NEUTRON NOISE IN NUCLEAR REACTORS. Austin Blaquiere (Institut National des Sciences et Techniques Nucléaires, [Saclay, France]) and Roza Pachowska. Bull. inform. sci. et tech. (Paris), No. 52, 2-27(June 1961). (In French)

The power of a nuclear reactor, in the operating conditions, presents fluctuations due to various causes. This random behavior can be included in the study of noise. Among other sources of noise, analysis was made of the fluctuations due to the discontinuous emission of neutrons from an independent source; and to the multiplication of neutrons inside the reactor. The method used made use of the analogies between the rules governing a nuclear reactor in operation and a number of radioelectrical systems, in particular the feed-back loops. The reactor can be characterized by its passing band and is described as a system submitted to a sequence of random pulses. In non-linear operating conditions, the effect of neutron noise is defined by means of a non-linear functional, this theory is thus related to previous works. This leads, in particular in the case of nuclear reactors, to some results given in the case of radioelectrical loops. (auth)

28763 PHYSICAL AND TECHNOLOGICAL TESTS MADE DURING THE STARTING PERIOD OF THE G2-G3 REACTORS. I. PHYSICAL TESTS. A. Teste du Bailler. II. TECHNOLOGICAL TESTS. F. de Laage de Meux. Bull. inform. sci. et tech. (Paris), No. 52, 28-44(June 1961). (In French)

Neutron and thermal specifications for G-2 and G-3 reactors were established from computations which due to their recent development required an experimental check, as careful as possible, taking into account the needs of the operation of these reactors. Experiments were made during the starting period and power runs of G-2 and G-3. They allowed satisfactory operating conditions to be obtained and, at the same time, provided useful information for future graphite-moderated gas-cooled reactors. Tests made on a pre-stressed vessel are described. During the power run, an over-heating of the concrete was observed, requiring a number of modifications. Difficulties rose during the unloading of fuel elements and the removing system had to be improved. A can failure was detected during the second power run of G-2. Decontamination of polluted channels was effected by brushing. Afterwards, the reactor was operated at its nominal power. (auth)

28764 DETERMINATION OF REACTOR PARAMETERS. [PART] III. Lajos Bata and Peter Vertes (Central Physical

Research Inst., [Hungary]). Energia és Atomtech., 14: 274-83(1961). (In Hungarian)

Continuing the description of reactor parameter measurements (Energia és Atomtechnika, 13, 490-5 (1960) and 14, 32-9 (1961)), critical and exponential experiments are discussed. The method involving the determination of the multiplication constant is of special interest for Hungary because it can be used conveniently for study of the VVRSz water moderated and reflected, enriched reactor system obtained from the Soviet Union. A heterogeneous subcritical system was built, placing a $5 \cdot 10^6$ n/sec source in its center and using a BF_3 counter for the flux measurements. The critical mass was found to be $2816 < m_c < 2944$ g U^{235}. The resonance flux distribution satisfied the thermal flux distribution equation. The theoretical problems presented by the exponential experiment, which is also very useful for determining the multiplication constant, are discussed in detail. Good agreement was obtained between the theoretical ($B_0^2 = 0.96 \cdot 10^{-2}$ cm^{-2}) and the experimental ($B_0^2 = (0.99 \pm 0.05) \cdot 10^{-2}$ cm^{-2}) values of the material buckling. (TTT)

28765 BUCKLING MEASUREMENTS BY THE FUEL REPLACEMENT METHOD. Jozsef Vigassy (Central Physical Research Inst., [Hungary]). Energia és Atomtech., 14: 283-17(1961). (In Hungarian)

The buckling is usually determined by means of exponential experiments. In graphite-moderated reactors only the measurement of zones with low buckling yields precise values; light water-moderated systems require unusually large amounts of material for the measurement. A method was developed combining the advantages presented by critical and exponential experiments, making it possible to measure high buckling values while making use of only small amounts of material. It consists in replacing a portion of a reference reactor with a lattice made of the material under study. The reference reactor should have a buckling and a neutron spectrum close to that of the system investigated. The deviation between the critical properties of the reference reactor and the newly obtained two-region reactor allow calculation of the buckling of the experimental material. Care must be taken not to interfere with the safety features of the reference reactor. The method is useful for determining the effect of fuel element variations in heavy water-moderated systems; its experimental simplicity is its chief advantage although the calculations needed are quite involved. (TTT)

28766 DIFFUSION OF NICKEL IN A NICKEL–MOLYBDENUM ALLOY IN AN ELECTRIC FIELD. D. F. Kalinovich, I. I. Kovenskii, M. D. Smolin, and I. P. Frantsevich (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Kiev). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 5, 108-10(May 1961). (In Russian)

Electrotransportation and diffusion of nickel is investigated in an alloy of nickel with 9.24% by weight of molybdenum, using tracer Ni^{63}. It is established that in an electric field nickel migrates toward the anode. Effective charges of nickel ions are calculated for the temperature interval 1150–1300°C. It was determined that nickel ions are forced to migrate by conduction electrons. (auth)

28767 ORGANIC COOLANTS IN REACTOR CONSTRUCTION. P. A. Palibin, A. P. Smirnov-Averin, Yu. G. Sevast'yanov, L. A. Bulanov, and G. A. Shasharin. Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 5, 127-38(May 1961). (In Russian)

A review is given of properties and advantages of organic power reactor coolants. The thermal stability and other pertinent data on various organic coolants are tabulated, and technological data on organic cooled reactors are discussed. (R.V.J.)

28768 ANALYSIS OF POWER FLUCTUATIONS IN THE HRT. Jitsuya Hirota (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 440-8(June 1961). (In English)

Power fluctuations in the HRT have been studied intensively. The power deviations have Gaussian behavior, and the standard deviations provide quantitative roughness of the reactor power. By use of auto-correlation analysis, resonance characters of the fluctuations under various operating conditions were obtained. So far as small changes are concerned, transfer functions of a simplified physical model were calculated. Comparing the results of calculation with the Fourier amplitude of power deviation indicates that the core probably contains gas bubbles. Changes in the behavior of the power fluctuations due to the fuel instability were also investigated. The analysis gives some insight into the mechanism occurring in the HRT. (auth)

28769 THE ROLE OF DISLOCATIONS AND INCLUSIONS IN THE FORMATION OF GAS BUBBLES IN THE IRRADIATED FISSILE MATERIAL. Fumio Hashimoto (Kawasaki Dockyard Co., Ltd., [Japan]). J. At. Energy Soc. Japan, 3: 449-56(June 1961). (In Japanese)

The interaction of vacancies, interstitials, and gas atoms produced in the fissile material by irradiation with dislocations or inclusions are investigated in detail, and the process of nucleation of gas bubbles is discussed. The general consideration is given, and the calculation is carried out in the case of uranium based on the general considerations. The major conclusions are as follows: for irradiation at $T \lesssim -50$°C, no nucleus of the gas bubble is formed; for irradiation at -50°C $< T \lesssim 500$°C, the nuclei of gas bubbles are formed in the neighborhood of the dislocation, and the average spacing of nuclei is about 10^{-5} cm; and for irradiation at 500°C $< T \lesssim 670$°C, the nuclei of gas bubbles are formed near inclusions or grain boundaries. (auth)

28770 TABLE FOR NEUTRON ACTIVATION. Franz Baumgärtner (Technische Hochschule, Munich). Kerntechnik, 3: 356-69(Aug. 1961). (In German)

More data are necessary for the quantitative calculation of a reactor activation than are given in the nuclide charts. Therefore, there was an urgent need to assemble all the data required for the activation with reactor neutrons, especially under high resonance neutron flux. It was decided to assemble and chart the activation factors of each radionuclide in such a manner that only the specific characteristics of the respective sample, that is the weight and the time of irradiation, have to be combined with a single factor in order to obtain the activity of a radionuclide. The chart given fulfills these requirements and was constructed in a manner that proved most useful in hundreds of irradiations. (auth)

28771 AUXILIARY SYSTEMS AT WATER-COOLED REACTORS. A. Müller (Deutsche Babcock & Wilcox-Dampfkessel-Werke A. G., Oberhausen, Ger.). Kerntechnik, 3: 370-3(Aug. 1961). (In German)

The side effects occurring during the generation of nuclear energy and the auxiliary equipment necessary for their control are discussed. Several circuits of the primary water purification plant required for water-cooled reactors and of the plants for the treatment of radioactive waste gases and waste waters are presented. (auth)

28772 NUCLEAR REACTORS WITH MAXIMUM PROMPT NEUTRON LIFETIME. J. Ernest Wilkins, Jr. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nuclear Sci. and Eng., 10: 331-6(Aug. 1961).

Given a region occupied by uniformly distributed moder-

ator, it is conjectured that in order to achieve a reactor with maximum prompt neutron lifetime, the fuel should be distributed uniformly throughout the region. This conjecture is shown to be valid for a large class of thermal reactors that can be described by a multigroup diffusion model. (auth)

28773 ASYMPTOTIC REACTOR THEORY. K. M. Case, Joel H. Ferziger, and P. F. Zweifel (Univ. of Michigan, Ann Arbor). Nuclear Sci. and Eng., 10: 352-6(Aug. 1961).

It is shown that the results of "asymptotic reactor theory" may be derived simply from the condition that an infinite medium (rather than the correct finite medium) diffusion equation be used to describe the thermal neutron flux in a reactor. In an asymptotic (bare, homogeneous, thermal) reactor, it is possible to describe the thermal flux through such an equation if the kernel of the infinite medium equation is defined properly, even when the reactor is not "large." The relation between the kernels of the two equations is explicitly derived, and the conditions examined under which the kernel of the infinite medium equation can be interpreted physically as the Green' function of the infinite medium slowing-down problem. It is found that this interpretation is not restricted to the case in which the infinite medium, slowing-down problem can be treated accurately by diffusion theory. Rather, the restriction is that the "asymptotic" portion of the flux give a reasonably accurate description of the finite medium Green's function. Thus, the use of transport kernels in asymptotic reactor theory is meaningful. (auth)

28774 CONSISTENT P_1 CRITICALITY CALCULATIONS. P. F. Zweifel (Marquardt Corp., Van Nuys, Calif.) and Joel H. Ferziger. Nuclear Sci. and Eng., 10: 357-61(Aug. 1961).

A "consistent P_1" (P_1 = slowing down kernel in first approximation) four-factor formula is derived. This formula, which contains a term not found in the usual four-factor formula, introduces a change in $k_{eff} \sim D^2B^2$ where D is the thermal diffusion coefficient and B is the buckling. The term is negative for hydrogen and positive for other moderators. The correction is at most 1% Δk for a practical system. Since the four-factor formula is not expected to be accurate to 1%, it is proposed that this term be used mainly as a criterion for determining whether consistent P_1 multigroup calculations are required, or whether simple group diffusion methods suffice. By using the consistent P_1 equations when the term D^2B^2 is of the order 1%, the introduction of a consistent error into the reactor calculations is avoided. The consistent P_1 multigroup equations are displayed. (auth)

28775 ESCAPE-PROBABILITIES IN ASYMPTOTIC REACTOR THEORY. S. Yip and P. F. Zweifel (Univ. of Michigan, Ann Arbor). Nuclear Sci, and Eng., 10: 362-6 (Aug. 1961).

Explicit formulas are given for one-velocity escape probabilities from absorbing and (isotropic) scattering slabs in vacuo, as calculated by the methods of asymptotic reactor theory. The results are compared with exact numerical calculations, diffusion theory, and a variational principal. Even for slabs as thin as two mean free paths, the asymptotic calculations are found to be highly accurate. By comparing the asymptotic methods with some multiple-scattering calculations for infinite cylinders, an extrapolated boundary is defined for the cylinder, and in this fashion explicit formulas are obtained for the escape probabilities from finite cylinders. (auth)

28776 ON THE RANGE OF VALIDITY OF NONLINEAR REACTOR DYNAMICS. Elias P. Gyftopoulos and Jacques Devooght (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng., 10: 372-6(Aug. 1961).

Space-independent, conventional, nonlinear reactor dynamics equations are derived by a second-order perturbation method. A general criterion is derived indicating the conditions under which it is purposeful to use the nonlinear equations. It is shown that the range of validity of nonlinear dynamics is not unlimited, and that in case of large deviations from equilibrium higher order perturbation terms are required. (auth)

28777 COMPARISON OF WILKINS EQUATION WITH EXPERIMENTS ON WATER SYSTEMS. Luis de Sobrino and Melville Clark, Jr. (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng., 10: 377-83(Aug. 1961).

The neutron spectra in homogeneous and heterogeneous water systems are calculated using the Wilkins model. The approximations involved are discussed and the results are compared with experimental measurements. (auth)

28778 COMPARISON OF THE WILKINS EQUATION AND HIGHER ORDER APPROXIMATIONS FOR SOLID MODERATORS. Luis de Sobrino and Melville Clark, Jr. (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng., 10: 384-7(Aug. 1961).

Approximations that include the first two terms in the inverse mass expansion are developed for the Boltzmann equation for anisotropic moderators. An asymptotic solution is obtained. The results for beryllium and graphite are compared with the results of the Wilkins approximation. It is seen that this approximation constitutes an improvement over the gaseous model because the error in the Wilkins model produced by neglecting higher orders in the inverse mass expansion is partially cancelled by the effects of crystalline binding. (auth)

28779 A STUDY OF WILKINS EQUATION. Luis de Sobrino and Melville Clark, Jr. (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng., 10: 388-99 (Aug. 1961).

The Wilkins equation for 1/v capture, with a constant leakage term, is studied. The solution that is regular at the origin and its asymptotic behavior are discussed. Series expansions for the joining factors are given and the corresponding eigenvalue problem is studied. Tabulations of the eigenfunctions are presented for values of the parameters that are of practical interest. (auth)

28780 SPATIAL DEPENDENCE OF THERMAL-NEUTRON SPECTRA AND THE INTERPRETATION OF THERMAL UTILIZATION MEASUREMENTS. Robert W. Deutsch (General Nuclear Engineering Corp., Dunedin, Fla.). Nuclear Sci. and Eng., 10: 400-1(Aug. 1961).

Measurements of the thermal utilization factor of a reactor may be made by foil activation analysis. These foils are usually placed in the fuel and moderator regions; it is noted, however, that foils should also be placed in the cladding and structural regions, in order to determine whether any strong neutron absorption takes place in these regions. It is also noted that corrections must be applied to the activation results to compensate for changes in cross section with neutron temperature. (T.F.H.)

28781 PROPOSED REACTOR RADIATION DAMAGE MONITOR. S. I. Taimuty (Stanford Research Inst., Menlo Park, Calif.). Nuclear Sci. and Eng., 10: 403-4(Aug. 1961).

A method is described for determining the damage caused by fast neutrons incident on solids. Foils of the material in question are irradiated, and atoms ejected (or sputtered) from the foils by the neutrons are collected on collector foils. The number of atoms ejected may be determined by

thermal neutron activation analysis of the collector foils. The application of this method to Cu is shown as an example. (T.F.H.)

28782 GASEOUS SUSPENSIONS—A NEW REACTOR COOLANT. Donald C. Schluderberg, Robert L. Whitelaw, and Robert W. Carlson (Babcock and Wilcox Co., Lynchburg, Va.). Nucleonics, 19: No. 8, 67-8; 70; 72; 74; 76 (Aug. 1961).

Suspensions of graphite in He, N_2, CF_4, air, and CO_2 are considered as reactor coolants. The suspensions have reduced pumping power, higher specific power, lower coolant volume fraction and pressure, and lower fuel temperature as compared with gas coolants. The heat transfer, pressure and coolant drop properties of the suspensions are studied. (T.F.H.)

28783 SIMULATION OF THE THERMAL LOOP OF A NUCLEAR REACTOR. Gian Paolo Caligiuri (Euratom, C.C.R., Ispra, Italy). Riv. ing., No. 6, 8p. (June 1961). (In Italian)

The interdependence of the various elements of a nuclear power plant is pointed out, and the problems involved in simulation of the thermal loop are discussed. An analysis and a block diagram of a model thermal system are offered. (T.R.H.)

28784 THE INFLUENCE OF THE CONCENTRATION OF A SUSPENSION OF URANIUM OXIDE ON THE STEAM CONTENT BY VOLUME UNDER BUBBLING CONDITIONS. M. A. Styrikovich, G. G. Bartolomei, Ya. G. Vinokur, and V. A. Kolokol'tsev (Inst. of Power Engineering, Academy of Sciences, USSR). Teploenergetika, No. 9, 19-22(1960).

The experiments were commenced with tests at atmospheric pressure using the uranium oxides U_3O_8 and UO_3 as the dispersed phase in condensate. Data are given on the particle size composition of the oxides used, which were mostly greater than 10 microns. The steam content by volume of the oxide suspension was determined by irradiation with gamma rays. The formula that was used in the determinations is given and experimental justification for its use is provided. It was shown that the irradiation absorption factor does not depend on the thickness of the irradiated layer or on the fineness of the suspension, at any rate within the range of values tested. Tests were next made to determine the influence of the structure of the suspension on the mean steam content by volume. and mean values of steam content were calculated. Tests carried out with the system water—air and with suspension—air showed that with concentrations of U_3O_8 up to 10% in the water its presence has no influence on the air content of the suspension by volume as compared with pure water. Increase in the concentration of the suspension above 30% causes some diminution in the air content. After these preliminary tests the main series of tests were made on the system suspension—steam. The tests were made on an atmospheric pressure column made of stainless steel with sight glass. Irradiation was effected with a source of Co^{60} with an activity of about 10 millicuries. Brief details of the experimental procedure are given. From the tests, local and mean values of the volumetric steam content were obtained for various rates of passage of steam with columns of different heights and suspensions of different concentrations of the two oxides of uranium. The distribution of steam content by height is similar to that for condensate. There is an initial section on which the steam bubbles are stabilized a section of steady motion where the steam content by volume remains practically constant and an upper section of fairly rapid increase in steam content with height. Increase in the uranium oxide content up to 12 to 14% reduces the steam content slightly on the stabilized section since the steam bubbles rise somewhat more rapidly than in pure water. Increasing the concentration of uranium trioxide from 4 to 20% causes very slight increase in the volumetric steam content on the stabilized section. The volumetric steam content on the stabilized section is practically independent of changes in the level in the range of 200 to 600 mm and depends mainly on the referred steam velocity. The difference between the volumetric steam contents of suspension and condensate decrease with increase in the referred velocity of the steam. For referred speeds in the range 0.7 to 0.9 m/sec the difference in the value of the steam content for condensate and suspension does not exceed 3 to 5%. (OTS)

28785 NUCLEAR FUEL ELEMENT DEVELOPMENT. R. Carson Dalzell. H. W. Gillett Memorial Lecture. Philadelphia, American Society for Testing Materials, 1960. 18p.

A review of the developments made in reactor fuel elements is presented. Such topics are discussed as reactor environment; design factors which include radiation effects, metallurgical properties, coolant effects, and shape and size; requirements; standardization; and fabrication. Other problems discussed in relation to fuel elements are design changes, cladding, life, cost, and composition. Also briefly mentioned are the material problems in the fabrication of the elements such as fissionable materials, thermal neutron absorbers, fuel diluents, and barrier or bonding material problems. (N.W.R.)

28786 REACTORS OF THE WORLD. Second Series. New York, Simmons-Boardman Publishing Corp. 28p. $3.50(Card Covers), $4.50(Cloth Bound).

The characteristics, designs, and other important data are presented for the following reactors: Dragon, Merlin, Pluto, Zenith, Hinkley Point, G-1, G-2, G-3, Organic Moderated Reactor Experiment, N. S. Savannah, NRU, BR-3, Latina, and Halden. (T.F.H.)

28787 NUCLEAR REACTOR INSTRUMENTATION. M. W. Jervis. "Nuclear Engineering" Monographs. London, Temple Press Ltd., 1961. 80p. $2.95.

The items of instrumentation necessary for the start-up, running, and protection of reactors are discussed. In addition to the measurement of temperatures, nuclear quantities. pressures, and flows, the detection of faulty fuel elements and health physics activities are described. Special reference is made to modern techniques of safety systems and automatic data logging. (N.W.R.)

28788 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR MODERATOR STRUCTURES. Stanley Hackney and Peter Neil Munn (to United Kingdom Atomic Energy Authority). British Patent 874,018. Aug. 2, 1961.

A radially-acting restraint for a graphite reactor moderator structure is described. The peripheral restraint is characterized in that between the restraint means and the moderator structure is interposed a series of wedges imposing a centripetal force on the moderator structure and a spring loaded thrust rod, radiation shielded, for applying a load to the wedges. The wedges are cuboids divided into three equal parts by two cuts each extending outwardly from the same diagonal of the top face and finishing on the ends at the bottom face which is transverse to the diagonal of the top face, the upper edge of the center part and the lower corners of the outer parts being removed. A series of the wedges are imposed one upon the other and the angle of the cuts is made progressively more acute from wedge to wedge down through the series. (N.W.R.)

28789 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Douglas English

and Hywel Arfon Roberts (to United Kingdom Atomic Energy Authority). British Patent 874,039. Aug. 2, 1961.

A fuel element comprised of a cluster of fuel rods arranged in spaced parallel relationship is described. The sheathed fuel rods are arranged in triangular lattice with transverse support grids adapted to locate the ends of the rods and allow some longitudinal movement. Spring loaded spacing members (coarse pitch coil springs or twisted flat metal strip adapted to act as turbulence promoters) are inserted between and in contact with the rods to maintain lateral stability. Each rod has a locating spigot at each end to engage the support grids, one of the spigots has grid engagement slots in its end surface for the intersecting wires. (N.W.R.)

28790 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL MATERIALS. Henry Lloyd, Jack Williams, Christopher Cameron Hope Wheatley, and Dennis George (to United Kingdom Atomic Energy Authority). British Patent 874,964. Aug. 16, 1961.

A ceramic fuel material consisting of a fissile oxide dispersed in a nonfissile oxide is described which has very low permeability to fission product gases at high temperatures. The nonfissile oxide may be Al_2O_3, MgO, BeO, or ZrO_2 to which an additional oxide, such as SiO_2, is added to cause the formation of a liquid phase during sintering. The preferable oxide, however, is an aluminous porcelain containing Al_2O_3, SiO_2, MgO, and CaO mixed in the proportions 87 : 10 : 2 : 1 by weight and melting at 1500°C. Several examples of fuel material prepared using such mixtures are described. (D.L.C.)

28791 IMPROVEMENTS IN OR RELATING TO MODERATOR CORE STRUCTURES FOR NUCLEAR REACTORS. Michael Bayer (to General Electric Co. Ltd.). British Patent 875,191. Aug. 16, 1961.

A moderator core structure is designed with means for stabilizing the core against horizontal forces, e.g., earthquakes. The structure comprises a cylindrical core with a bracing structure adapted to resist core distortion while permitting vertical movement between the bracing structure and the core. (D.L.C.)

28792 IMPROVEMENTS IN NUCLEAR REACTORS FOR PRODUCING STEAM. (to Société Rateau). British Patent 875,329. Aug. 16, 1961.

A boiling reactor is designed which combines the advantages of the boiling type and gas-cooled type reactors in that it obtains directly superheated steam while avoiding instabilities. The reactor has its fuel elements located in tubes in the water vessel and has upper and lower vapor zones, communication between the two zones being formed by the tubes. In order to escape from the reactor, the steam must force itself from the upper zone past the fuel elements to the lower zone; thus, heat transfer from the fuel elements to the water is effected through steam, and the escaping steam becomes superheated. (D.L.C.)

28793 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Metallwerke Plansee Gesellschaft m.b.H.). British Patent 876,021. Aug. 30, 1961.

A high-strength fuel element is described which comprises a protective tube containing a matrix of uranium metal or alloy in which are embedded shaped bodies of at least one transition metal of the 4th to 6th or 8th group of the periodic table or an alloy or a compound thereof. The protective tube is of a metal or an alloy having a melting point above that of the uranium metal or alloy employed. The shaped bodies may be wires, rods, fabric, sheet, or rings, and their use not only increases the mechanical strength of the fuel element but also ensures the wetting of the tube walls by the uranium metal or alloy. It is also possible to use the shaped bodies to alter the temperature distribution in the fuel element. The fuel element may be made simply by packing the shaped bodies into the protective tube and then pouring in molten uranium metal or alloy. (D.L.C.)

28794 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. Douglas Frank Seymour, John Walton, and John Malcolm Alexander (to English Electric Co., Ltd.). British Patent 876,232. Aug. 30, 1961.

A gas-cooled, graphite-moderated reactor is designed with temperature-sensitive flow-regulating means located in the fuel channels for keeping the temperature of fuel elements substantially constant. The flow-regulating means comprises a body member having a coolant passage within, a movable member disposed in the passage, and a temperature-responsive operating means arranged to operate the movable member to decrease the effective flow area of the passage as the coolant temperature decreases. (D.L.C.)

28795 BOILER-SUPERHEATER REACTOR. (to U. S. Atomic Energy Commission). British Patent 876,272. Aug. 30, 1961.

A boiling water reactor is designed which is stable, responds directly to the power demand of the turbogenerators, has a small volume of liquid water circulated per unit quantity of steam produced, and is less likely to have fuel element failures. The core comprises a plurality of trains of connected fuel tubes, through which pressurized water passes in moving from the upper plenum downwards. Upon being forced through orifices in the connectors between fuel tubes against the outer surfaces, the pressurized water is converted into superheated steam which passes upwardly into a steam outlet conduit. Thermostatic gates are connected to the bottom ends of the trains as safety valves, whereby damage to fuel tubes by overheated water is prevented; water passing through the thermostatic gates is converted into superheated steam and passed to the outlet conduit. Technical details of the preferred embodiment of the reactor are given. (D.L.C.)

28796 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Metallwerk Plansee Gesellschaft m.b.H.). British Patent 876,399. Aug. 30, 1961.

A novel method of preparing reactor fuel elements is described which results in a porous uranium alloy skeleton impregnated with a light metal or alloy. The method consists of forming the uranium alloy skeleton by powder metallurgy methods and impregnating the skeleton with molten light metal or alloy. The uranium should be alloyed with one of the transition metals of the 4th, 5th, and 6th groups of the periodic table, and the light metal or alloy should have a melting point at least ~100°C less than that of the uranium alloy. Examples of the method using molten aluminum alloys are described. (D.L.C.)

28797 NUCLEAR REACTOR FUEL ELEMENT. C. W. Wheelock and E. B. Baumeister (to U. S. Atomic Energy Commission). U. S. Patent 2,999,058. Sept. 5, 1961.

A reactor fuel element utilizing fissionable fuel materials in plate form is described. This fuel element consists of bundles of fuel-bearing plates. The bundles are stacked inside of a tube which forms the shell of the fuel element. The plates each have longitudinal fins running parallel to the direction of coolant flow, and interspersed among and parallel to the fins are ribs which position the plates relative to each other and to the fuel element shell. The plate bundles are held together by thin bands or wires. The ex-

tended surface increases the heat transfer capabilities of a fuel element by a factor of 3 or more over those of a simple flat plate.

28798 NUCLEAR REACTOR. Michael Treshow (to U. S. Atomic Energy Commission). U. S. Patent 2,999,059. Sept. 5, 1961.

A boiling-water nuclear reactor is described wherein control is effected by varying the moderator-to-fuel ratio in the reactor core. This is accomplished by providing control tubes containing a liquid control moderator in the reactor core and providing means for varying the amount of control moderator within the control tubes.

28799 CONTROL MEANS FOR A NUCLEAR REACTOR. Robert J. Teitel (to U. S. Atomic Energy Commission). U. S. Patent 2,999,060. Sept. 5, 1961.

A control means is described for a reactor which employs a liquid fuel consisting of a fissile isotope in a liquid bismuth solvent. The liquid fuel is contained in a plurality of tubular vessels. Control is effected by inserting plungers in the vessels to displace the liquid fuel and provide a critical or non-critical fuel configuration as desired.

Power Reactors

28800 (CEND-129) DESIGN AND DEVELOPMENT. ABWR Quarterly Progress Report, January 1 through March 31, 1961. (Combustion Engineering, Inc. Nuclear Div., Windsor). May 15, 1961. Contract AT(10-1)-967. 62p. (IDO-19029)

A data summary of the characteristics of the PL-1 and PL-2 plants is given. Revisions were made in the plant systems to improve performance; conserve materials, weight, and space; and to provide for simple operation. Data is included on the reactor, electrical system, environment. fuel elements, core geometry, control, main stream system, condensate system. feedwater system, purification system, shield cooling system, raw water purification system, lube oil cooling system, plant heating, service water system, and shipping. (M.C.G.)

28801 (CF-61-7-54) HRE-2 REPLACEMENT REACTOR STUDY NO. 2. R. H. Chapman (Oak Ridge National Lab., Tenn.). July 3, 1961. 56p.

The results of a second HRE-2 replacement reactor design study are reported in which the mechanical, hydrodynamic, and nuclear aspects are discussed in detail. The reactor design which evolved from this study has a 21-in. dia × 42-in. long cylindrical core (vol = 200 liters) partially reflected by a 4-in. thick beryllium reflector, surrounded by a thorium blanket, and enclosed in a 52.0-in. ID steel pressure vessel. By making the Zircaloy-2 core tank, beryllium reflector, and thoria blanket removable through a flanged closure on the pressure vessel, considerable versatility is readily available for a variety of reactor experiments. A gross breeding ratio of 1.07 appears attainable by surrounding the core and reflector with a thoria blanket approximately 6-in. thick. The thoria would be in the form of pellets at 5000 g Th/l, and the core would be fueled with a 6.56 g U-233/l fuel solution. Corresponding maximum core wall power density would be about 5.6 kw/l per Mw of core power; the core could be operated readily at 10 Mw. By varying the core and blanket compositions and configurations, other desirable nuclear characteristics are possible. System layouts are described, based on using the existing reactor steam generators in two parallel core heat removal loops. The proposed layout of the system is accomplished with only a 10 to 12% increase over the present system volumes (of interest for storage and containment purposes). (auth)

28802 (CF-61-7-85) FUELING COST ESTIMATES FOR THE BURN-UP AND DISCHARGE FUEL CYCLE OF CANDU-TYPE NATURAL-URANIUM DIOXIDE HEAVY WATER POWER REACTORS. R. Van Winkle (Oak Ridge National Lab., Tenn.). July 19, 1961. 49p.

Fuel cycle costs for the "burn-up-and-discard" fuel cycle were estimated for CANDU-type natural-uranium dioxide, heavy water pressure-tube reactors, using the ground rules of the Thermal Breeder Reactor Evaluation group at ORNL, to compare with costs claimed by the Canadians who use slightly different cost accounting bases. The high-capital-cost disadvantage of this type of reactor is expected to be overcome by the attainment of low fuel cycle costs made possible by high burn-ups of low-priced natural uranium in the range of 8700 to 10,000 MWD/tU. Fuel costs, exclusive of D_2O inventory but including fuel inventory charges at 12.7% per year of natural uranium, lie in the range 1.50 to 1.90 mills/kwhr based on current fabricated fuel prices of \$80 to 90/kg UO_2. The price of fabricated fuel is expected to decrease to \$50 to 60/kg UO_2 after 1965, giving fuel costs of 0.94 to 1.28 mills/kwhr. Using an annual fixed charge of 12.7% plus 2% annual loss rate, the D_2O cost is ~1.02 to 1.20 mills/kwhr. Plutonium recovered from natural uranium exposed to 8700 MWD/t and recycled with spent uranium blended with fresh uranium was found to add approximately 25% to the effective burn-up of natural uranium in one example. Only about 3 kg of fissionable plutonium are present in natural uranium after an exposure of 8700 to 9700 MWD/t. (auth)

28803 (CF-61-8-29) FABRICATION AND INSPECTION PROCEDURES FOR EXPERIMENTAL GAS-COOLED REACTOR BURST-SLUG-DETECTION TUBE AND THERMOCOUPLE PENETRATIONS. G. M. Slaughter and T. R. Housley (Oak Ridge National Lab., Tenn.). Aug. 14, 1961. 21p.

Satisfactory methods were developed for penetrating the stainless steel burst-slug-detection tubes and stainless steel-clad thermocouples through the carbon steel pressure shell of the Experimental Gas-Cooled Reactor (EGCR). The burst-slug-detection system permits the positive identification of a channel containing a defective fuel element, while the thermocouples will be used to measure temperatures from numerous points within the reactor. Both types of penetrations require the welding of relatively thin-walled components to thicker members under conditions of very limited accessibility. Suitable joint designs were determined and adequate fabrication and inspection procedures established in the construction of prototype demonstration assemblies. Conventional welding and brazing equipment and joining procedures were used throughout. Although accessibility in this application is definitely limited, it appears that welds and brazes of high quality can be made if carefully trained operators are utilized. (auth)

28804 (DLCS-1480115) CORE I CONTROL ROD DRIVE MECHANISM PERIODIC TEST. CORE I, SEED 2. Test Evaluation, T-550011-E. First Issue, [July 1961]. (Duquesne Light Co., Shippingport, Penna.). Section 1. 27p.

A test is reported of the operating conditions of the control rod drive mechanisms of the Shippingport PWR. The stator phase-to-ground and phase-to-phase resistance of the mechansims are checked. Each of the control rods is scram tested. Tests of the latch current and the mechanism rotation are performed. (T.F.H.)

28805 (DM-64) OPTIMIZING ORGANIC-LIQUID-COOLED HEAVY-WATER NATURAL-URANIUM REACTOR DESIGN FOR SHUT-DOWN REFUELLING. W. B. Lewis (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 5, 1961. Revised July 10, 1961. 29p. (AECL-1291)

Taking advantage of the expected properties of uranium monocarbide fuel in relatively massive rods, a specific, 150 MW(e) reactor design is suggested for shut-down refuelling. The fuel consists of 7-rod bundles of 3 cm diam. solid rods in about 300 channels 400-cm long. Such a design is also attractive for on-power refuelling. Basic analysis shows that any practical and economical design for shut-down refuelling requires a combination of high fuel burn-up, high thermal-to-electrical conversion efficiency, moderate specific power rating and moderate total power. To support the cost of the heavy water inventory, the total power (P eMW) must not be too low. At a specific power rating of the fuel (R) averaging 6 thermal MW/tonne U or less, the competitive neutron absorption by the fuel overrides the absorption in the organic coolant. A high burn-up (B) of about 10,000 MWD(th)/tonne natural U results. The high outlet temperature of the organic coolant, 400°C will raise high pressure steam to 170 atmos, yielding a net station efficiency of 35%. The reactivity drop over each operating period (t_f) can be made less than $Rt_f/45$ = 6.6 milli-k, for t_f = 50 days. Fuel management requiring each fuel element to occupy only two successive positions in the reactor limits re-positioning every 50 days to $2\,P.t_f/eB = P/35$ tonnes U or a fraction $2t_fR/B$ = 6% of the total fuel. The suggested design depends on some extrapolation from established reactor lattice and coolant channel measurements. (auth)

28806 (GEAP-3561) T7 TANKER LOCKING PISTON CONTROL ROD DRIVE SCRAM ANALYSIS. John Roberts and S. F. Armour (General Electric Co. Flight Propulsion Lab. Dept., San Ramon, Calif.). Oct. 5, 1960. For General Electric Co. Atomic Power Equipment Dept., San Jose, Calif. Contract AT(04-3)-189. 76p.

A "locking piston" control rod drive mechanism is described that is used in a boiling water marine propulsion reactor. The hydraulic scram system associated with this drive mechanism is analyzed, taking into consideration the effects of upward and downward accelerations of 0.8 g. (T.F.H.)

28807 (GEAP-3702) THE DEVELOPMENT OF A SCHEDULING COMPUTER FOR THE BIG ROCK PLANT. Eric S. Beckjord. Includes Appendices: A. SURVEY OF INCENTIVES FOR USE OF A COMPUTER IN REACTOR CONTROL. D. L. Fischer and C. L. Miller. Feb. 1, 1961. B. NUMERICAL INTEGRATION OF THE XENON EQUATIONS FOR CONSUMERS. W. H. Harker. Mar. 20, 1961. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Contract AT(04-3)-361. 71p.

The basic work for development of a scheduling computer for the Consumers' Big Rock Plant is outlined. The purpose of the computer is to make feasible higher power densities by operation closer to fuel element burnout limits and to maximize fuel burnup. The computer functions are described. (D.L.C.)

28808 (GNEC-153) ANALYSIS OF THE INITIAL NUCLEAR SUPERHEAT CRITICAL EXPERIMENTS. SUPPLEMENTARY STUDY RELATED TO BONUS AND NUCLEAR SUPERHEAT PROGRAMS. (General Nuclear Engineering Corp., Dunedin, Fla.). Jan. 30, 1961. Contract AT(40-1)-2674. 91p.

A critical experiment program is carried out in a configuration similar to the BONUS reactor. The results give information concerning: the effects of different boiler-superheater geometries; the reactivity changes associated with superheater voiding or flooding; power regulation between the boiler and superheater regions; epithermal transmission probabilities for B-stainless steel and Cd control rods; the power flattening characteristics; and void simulation properties. The calculational methods used in the study predict the measured reactivity and power distribution to within the limits of experimental accuracy. (T.F.H.)

28809 (JPL-TR-32-104) THE PLASMA CORE REACTOR. D. F. Spencer (California Inst. of Tech., Pasadena Jet Propulsion Lab.). Apr. 24, 1961. Contract NASw-6. 48p.

A preliminary analysis of the plasma core reactor concept, as applied to a rocket booster, indicates that the future potential for such a system is dependent on the solution of various technical problems. The important physical quantities that enter into the design of such a system are described, and areas requiring further investigation are suggested. In particular, experimental verification of the attainability of axial confinement is necessary to prove the system technically feasible. Also, theoretical and experimental studies of the energy transport from the fissionable plasma to the propellant are required. (auth)

28810 (LAMS-2561) TURRET CORE CALCULATIONS. G. H. Best, B. M. Carmichael, and R. J. LaBauve (Los Alamos Scientific Lab., N. Mex.). Feb. 1961. Contract W-7405-eng-36. 61p.

The calculations described are based on a model of the Turret reactor in which a distributed temperature profile is utilized. The critical mass for the model operating at a moderator volume average temperature of 1600°K and a power of 3 Mw is 6.8 kg of highly enriched uranium. A temperature coefficient of -8×10^{-5}/°C is obtained in the vicinity of operating temperature. An estimate of 20% Δk is obtained for the amount of shut-down control needed. (auth)

28811 (NAA-SR-5398) CONTROL ELEMENTS FOR SODIUM GRAPHITE REACTORS. P. F. Shaw (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 15, 1961. Contract AT(11-1)-GEN-8. 23p.

An investigation of three control element designs for sodium-graphite reactors is presented: the first design utilizes wire rope supporting a rod of neutron absorber material, permitting installation of the complete actuator in the upper end of a control rod thimble below the reactor loading face; the second concept uses overlapping fuel and absorber elements, enabling the column to be changed from a fuel rod to a poison rod by a short relative motion; the third concept involves the controlled admission of a neutron-absorbing gas into void areas in the active core, to control the reactivity level. Two complete assemblies using the wire-rope concept are fabricated and tested out-of-pile; one of these assemblies is prepared for operational testing in the Sodium Reactor Experiment. The fuel and absorber device is studied with regard to conceptual design. A preliminary investigation is performed on the neutron-absorbing-gas concept. (auth)

28812 (NDA-2131-24) POWER PATTERNS AND FUEL BURNUP IN A HEAVY WATER-MODERATED POWER REACTOR FOR VARIOUS REFUELING SCHEMES. C. Graves, R. Sullivan, J. Bobker, and F. Beers (Nuclear Development Corp. of America, White Plains, N. Y.). June 1, 1961. Contract AT(30-1)-2303. 65p.

In a design study of various heavy water-moderated power reactors, it was concluded that a direct cycle plant using boiling D_2O coolant had the most promise within the ground rules established by the United States Atomic Energy Commission. The particular design selected for further study is a pressure tube reactor with cold moderator and clustered-rod, natural UO_2 fuel elements clad with

Zircaloy-2. This reactor configuration is designated as HWR. As part of the HWR program, a study was made of the effect of various refueling schemes on fuel exposure and power patterns for heavy water-moderated, natural uranium-fueled power reactors. The methods used in the study and the application of these methods to the 200 Mw_e full scale reactor are described. The methods are directed primarily toward the prediction of conditions in the equilibrium regime of operation where the reactivity history is the same for each successive fuel reloading cycle. Of the refueling schemes considered, the radial outward fuel shift with axial fuel inversion yielded the highest average burnup of discharged fuel, but at the expense of a high radial maximum to average power. The calculations indicated a significant improvement in average burnup of discharged fuel for refueling schemes incorporating axial fuel inversion. For the outward and inward radial fuel shifts, the use of axial fuel inversion resulted in increases in burnup of 15 and 20% respectively. The inversion process resulted in relatively small changes in the radial flux pattern, as indicated by the one-dimensional calculations. However, further two-dimensional calculations should be made to determine the probable over-all increase in maximum to average power caused by the inversion process and to obtain more accurate burnup values based on calculated axial flux patterns. In terms of low power costs, the inward radial fuel shift with axial fuel inversion appears to be the most promising of the schemes considered. However, the final choice of the refueling scheme and the number of radial regions must await detailed reactor optimization calculations which include the effects of core size, fuel burnup, and reactor downtime on over-all power costs. (auth)

28813 (NDA-2148-4) STEAM-COOLED POWER REACTOR EVALUATION, STEAM-COOLED FAST BREEDER REACTOR. G. Sofer, R. Hankel, L. Goldstein, and G. Birman (Nuclear Development Corp. of America, White Plains, N. Y.). Apr. 15, 1961. Contract AT(30-1)-2303. 86p.

Conceptual design and economic studies of a steam-cooled fast breeder reactor that can also be used as a source of power are presented. Two reactor plant sizes were considered: a 300-Mw(e) central power station plant and a 40 Mw(e) plant. It was concluded that attractive economics and good breeding characteristics (breeding ratios from 1.27 to 1.42) can be achieved in steam-cooled PuO_2–UO_2 fueled fast reactors. Low capital costs can be obtained by a compact reactor core and the absence of large heat exchangers and complicated process systems. Reactor design data are discussed. Analysis showed that these reactors can be prevented from going prompt critical, when fully flooded, by incorporating a tolerable amount of high resonance absorption materials such as hafnium or indium. An increase in reactivity on loss of coolant was indicated by preliminary calculations. (M.C.G.)

28814 (NP-10550) TRANSIENT AND OSCILLATOR ANALYSIS FOR HAZARDS EVALUATION: COVERING TRIP LEVEL SETTINGS FOR THE ENRICO FERMI ATOMIC POWER PLANT POWER-LIMITING SYSTEM. C. E. Taulbee (Bendix Corp. Research Labs. Div., Southfield, Mich.). Nov. 1, 1960. For Atomic Power Development Associates. 32p. (BC/RDL-1621)

A transient and oscillator analysis for hazards evaluation covering trip level settings for the Enrico Fermi Atomic Power Plant power-limiting system is presented. Establishment of trip-level settings, review of trip-level settings from current simulation results, and description of simulator model are discussed. (M.C.G.)

28815 (NYO-9062) FUEL ELEMENT DEVELOPMENT PROGRAM FOR THE PEBBLE BED REACTOR. Phase II Summary Report, November 1, 1959 to October 31, 1960. (Sanderson and Porter, New York). Contract AT(30-1)-2378. 146p.

Coatings on the fuel element surface and coatings on individual fuel particles are being investigated for retaining fission products in fuel for the Pebble Bed Reactor. Ten fuel element specimens with surface coatings were subjected to varying amounts of high level irradiation. Cracks or pinholes were found in 6 of the coatings. Evidence indicated that the graphite matrix contributed to most of the failures. Release factors of the order of 10^{-9} for the Si–SiC coating under high-level irradiation existed for a period of about one month, however. The pyrolytic carbon coating showed some promise as a fission product barrier in several neutron activation tests. Fourteen batches of UO_2 particles were coated with Al_2O_3 by the vapor deposition process. Tests showed that this coating is an excellent barrier to fission products. In pyrolytic carbon-coated UC_2 particles there is no temperature limitation due to reaction between the particle coating and the graphite matrix. (M.C.G.)

28816 (NYO-9071) PROGRESS REPORT ON PEBBLE BED REACTOR PROGRAM FOR PERIOD JUNE 1, 1959–OCTOBER 31, 1960. (Sanderson and Porter, New York). Contract AT(30-1)-2207. 244p.

A description is given of analytical and development work in connection with the Pebble Bed Reactor concept. The principle involved in the reactor is the heating of graphite pebbles by the fission of contained uranium and transfer of the heat generated to helium which is circulated through the permeable bed. Fuel elements are being developed for the Pebble Bed Reactor which, based on irradiation results to date, are extremely effective in retarding the release of gaseous fission products. The effects of core materials as dictated by this development are appraised as well as the effects of local voidage caused by the core containing wall and other fixed graphite. A parametric survey was made of the nuclear and thermal characteristics of a series of cores using a modified two-group, two-region model developed for this purpose. An IBM 650 program was developed to handle this modified two-group model, which program was used in the parametric study. System activity was re-evaluated in light of information resulting from the Fuel Cycle Development Program. The use of an ultra-centrifuge to concentrate gaseous fission products to facilitate their removal from the system was investigated. Design principles were established for a continuous flow charcoal adsorber. A diffusion separation cell was sized, based on existing design data, for removal of fission products and contaminants. Experimental work was done on fuel loading patterns and the flow of balls through the bed. Ball bed friction factors were established over a range of Reynolds numbers from 5,000 to 50,000, and entrance and exit effects and surface roughness of fuel elements evaluated. Experimental work was done to determine if the thermal growth of the bed would result in fuel element failure. A mathematical model was developed to account for both radial and axial flow through the core resulting from its three-dimensional nature. Flow perturbations resulting from core hot spots were investigated using an IBM 650 program developed especially for this mathematical model. Further development programs for the Pebble Bed Reactor concept and gas cycle reactors in general are discussed. (auth)

28817 (ORNL-2425) ART REFLECTOR TEMPERATURE DISTRIBUTION. D. L. Platus, D. M. Miller, and

R. V. Meghreblian (Oak Ridge National Lab., Tenn.). Mar. 5, 1958. Decl. Jan. 5, 1960. Contract W-7405-eng-26. 43p.

A summary is presented of the application of the relaxation method to the determination of the steady state temperature distribution in the ART reflector beryllium during full power operation. (auth)

28818 (TID-13312) PERIODIC PRIMARY PLANT LEAK RATE TEST. CORE 1, SEED 2. Test Evaluation T-641102. (Duquesne Light Co., Shippingport, Penna.). First issue, June 14, 1961. 17p. (DLCS-2110137 (38 and 39)).

A series of three tests was run to determine the leak rates of two pressurizer relief valves and four reactor relief valves of the Shippingport PWR, under normal operating conditions. (T.F.H.)

28819 (TID-13385) FEDAL SYSTEM (OPERATIONAL TEST). CORE 1, SEED 2. Test Results T-643731. Section 3 of 5. (Duquesne Light Co., Shippingport, Penna.). First Issue, July 6, 1961. 65p. (DLCS-3500302, 03, 04, 05, and 06)

The ratio of delayed neutron activity of each blanket assembly to the average activity was measured with the failed element detection and location (FEDAL) system. The ratio of I^{137}/Br^{87} activity at the center of the FEDAL monitors varied from 2.01 to 0.85. The FEDAL multiport valve was found to be driven in the reverse direction from that indicated by the panel indicator lights, and a substantial (>75%) decrease in the indicated activities at full reactor power was observed. (D.L.C.)

28820 (WCAP-4057) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., CVTR PROJECT MONTHLY PROGRESS REPORT, JULY 1961. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Contract AT(30-1)-2289. 21p.

A Zircaloy-stainless steel joint was tested under conditions simulating those anticipated in the plant as well as under abnormal conditions. Examination of the joint showed it to still be in good condition. The location of the CVTR source was established between the legs of one of the centrally located pressure tube units. Testing of the control rod system was terminated after 8397 control rod excursions because excessive loads were experienced by the mechanism. The high load was caused by a thrust bearing being pinched between two thrust washers. Examination of bearings and gears did not show any abnormal wear. Coolant void coefficient measurements at the critical facility indicated negative coefficients for core loadings of 1.1% half-height clusters arranged on pitches of 8 × 6.5 in. and 8 × 8 in. Core control evaluations were made to establish the rod requirements for adequate shutdown. A total of 28 rods, 12 of which are boronated, provide adequate shutdown of the first core with 36 fueled U-tubes. Recommendations for the inspection and drying of the pressure tubes during plant life were formulated along with descriptions of the equipment required to perform the tasks. The CVTR in-pile loop was in operation for approximately ten months. Since mid-November 1960, it was irradiated for a total of 150 days. No significant problems were encountered during removal of the experiment from the WTR vessel. (auth)

28821 (AEC-tr-4066) THE TIME-DEPENDENT CHANGES OF OPERATION CONDITIONS OF THORIUM HOMOGENEOUS POWER REACTOR BEFORE THE STEADY STATE. Akira Oyama and Ryohei Kiyose. Translated from J. At. Energy Soc. Japan, 1: 64-9(1959). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 3240.

28822 PROPULSION SYSTEM USING A CAVITY REACTOR AND MAGNETOHYDRODYNAMIC GENERATOR. Richard J. Rosa (Avco-Everett Research Labs., Everett, Mass.). ARS (Am. Rocket Soc.) J., 31: 884-9(July 1961).

The propellant is heated in a cavity reactor, and emerges carrying particles of unfissioned U. The propellant then passes, at high temperature and pressure, through a MHD generator, in which it loses much of its energy. The low-temperature propellant and U are then separated in a U collector, and the propellant enters an accelerator, in which the energy lost in the MHD generator is returned to the propellant. The propellant is then ejected from the vehicle. The performance of hydrogen as a propellant is examined. (T.F.H.)

28823 CERAMIC COATINGS FOR PBR FUEL ELEMENTS. Lincoln D. Stoughton (Sanderson and Porter, New York). Atomics, 14: 16-20(July 1961).

Several methods for producing ceramic coatings on the fuel elements used in the Pebble Bed Reactor are described and compared. One method comprises depositing a thin coating of Si-SiC on the surface of the sphere; another method consists of coating the individual particles making up the sphere with alumina or pyrolytic carbon. The leakage of fission products from each of these types of coatings is found. (T.F.H.)

28824 SPECTRAL SHIFT CONTROL—A NEW REACTOR CONCEPT. Atomics, 14: 35-9(July 1961).

A method is described for increasing fuel lifetime, decreasing fuel cycle costs, and achieving uniform power distributions and high neutron economy in water cooled and moderated reactors. The moderator-coolant is a D_2O-H_2O mixture, which is rich in D_2O at the beginning of the fuel cycle and is gradually diluted with H_2O. The gradual dilution takes advantage of the neutron spectrum changes that occur upon fuel burnup, and eliminates the necessity for extensive control rod insertion during the beginning of the fuel cycle. The Spectral Shift Control Reactor (SSCR) that is proposed to utilize these concepts is described. (T.F.H.)

28825 PARTIAL FUEL RELOADING SCHEMES FOR NUCLEAR REACTORS. E. I. Grishanin, B. G. Ivanov, and V. N. Sharapov. Atomnaya Energ., 10: 565-71(June 1961). (In Russian)

To increase the efficiency of atomic power stations, both the constant and the variable cost factors must be reduced. This may be achieved by increasing the burnup level as the fuel's material and fabrication costs contribute greatly to the over-all energy-generating expense, especially if the spent fuel elements are not reprocessed. The burnup may be increased by replacing the used fuel elements according to a continuous scheme. In practice, this requires periodic shutdown of the reactor. A simplified control system may be employed because the number of shim rods may be decreased. Use of the partial reloading method permits a radially uniform energy generation which is more efficient than the usual method of evening out the flux by absorbing rods; on the other hand, the neutron leakage rate is increased. There is an optimum rate of reloading for each atomic power station; the availability of fuel reprocessing shifts the percentage of the fuel to be exchanged toward larger values. For the Soviet First Atomic Power Station this value was calculated to be 0.077. Similar computations were made for the I. V. Kurchatov Atomic Power Station, taking the reprocessing factor into consideration. (TTT)

28826 THE PROBLEM OF THERMODYNAMIC CYCLES OF ATOMIC POWER STATIONS. D. D. Kalafati. Atomnaya Energ., 10: 623-4(June 1961). (In Russian)

Yu. D. Arsen'ev et al. (Atom. Energ. 9, 133(1960)) dis-

puted this author's derivation of a formula which allows the determination of the optimum average temperature of the heat supply in the thermodynamic cycle of power reactors ("Fizika i Teplotekhnika Reaktorov," M. Atomizdat 1958, page 164), basing the calculations on the average temperature in the center of the fuel elements and in the cladding and the thermal factor entering in the power generating costs. In this rebuttal of the criticism, it is pointed out that the critics confused the steam saturation temperature of the regenerative cycle without water economizer with the original steam pressure corresponding to the average temperature of the non-regenerative cycle. The conclusions reached by the critics are refuted. (TTT)

28827 OPERATIONAL EXPERIENCE OF THE FIRST (SOVIET) ATOMIC POWER STATION. Yu. V. Evdokimov, V. Ya. Kozlov, V. G. Konochkin, L. A. Kochetkov, A. K. Krasin, V. V. Lytkin, V. S. Sever'yanov, B. A. Semenov, and G. N. Ushakov. Atomnaya Energ., 11: 12-18(July 1961). (In Russian)

The First Atomic Power Station has been operating satisfactorily for six years. At the start special efforts were made to reach the design parameters and to ensure the safety of the operations. The individual steps included startup from the cold state to the lowest controllable level corresponding to 0.01% of the nominal power, take-over of the system at that point by the automatic control system, rise to the desired power, stoppage and cooling down. The fuel element design was found to be very reliable; during the whole period no element had to be removed for malfunctioning. In order to obtain high burnup levels and to level out the flux distribution a partial reloading scheme was developed. Inspection of elements used for a period corresponding to 204 hours at full power at a burnup of 11 g/ton showed no cracks or other changes. A special emergency system prevents the escape of contaminated steam. The experimental loops installed in the reactor also functioned satisfactorily. (TTT)

28828 NEUTRON PHYSICS CALCULATION METHODS IN THE PHYSICAL LEVELING DESIGN OF POWER REACTORS. N. N. Ponomarev-Stepnoi and E. S. Glushkov. Atomnaya Energ., 11: 19-25(July 1961). (In Russian)

In view of the lack of uniformity in spatial distribution of the fuel elements, the neutron flux of a reactor is uneven, causing different levels of heat distribution in various points of the core. Achievement of the highest average heat generation in a power reactor system is limited by the requirement of providing for the maximum possible heat removal capacity from the element carrying the heaviest load. It is thus highly desirable to smooth out the flux. This can be achieved by a physical leveling which involves the redistribution of the fuel elements within the core or by means of a hydraulic method, redistributing the coolant input through the cooling channels on the basis of the geometric characteristics of the channels and the location of the fuel elements. If the heat exchanger surface per unit core volume remains unchanged during the physical flux leveling, the goal may be reached by changing the absorbing and scattering characteristics of the core materials. Equations were derived for solving this problem for thermal and intermediate reactors, with and without reflector. (TTT)

28829 THE LOCATION OF NUCLEAR CENTRALS BY THE EFFECTS OF THE DIFFUSION OF THE RADIOACTIVITY IN THE SURROUNDING ATMOSPHERE. Mario Mainardis. Atti ist. veneto sci., lettere ed arti, Classe sci. mat. e nat., 118: 111-18(1959-1960). (In Italian)

A study is being undertaken in Italy on the placement of reactors in small caverns. The purpose is the qualitative and quantitative determination of the porosity and the propagation velocity of the gas infiltration as a function of the solidarity of the rock and of various types of revetments applied to the rock. In the present work, the methods used in such research and the data obtained are summarized. (J.S.R.)

28830 THE PATHFINDER NUCLEAR PLANT. Clifton B. Graham (Allis-Chalmers Mfg. Co., Milwaukee). Mech. Eng., 82: No. 4, 67-70(Apr. 1960).

A description is given of the design and performance of the Pathfinder Nuclear Plant located near Sioux Falls, South Dakota. This station will use controlled recirculation and nuclear superheat with a boiling water type reactor. The design data and a plan view of the plant are given along with a schematic diagram of the reactor and the radial thermal neutron distribution for the boiling core alone and for the boiling core with superheater. The total plant heat output will be 203 Mw with the turbine-generator producing 66 Mw(e) gross. Net power is 62 Mw, resulting in an overall net plant efficiency of 30.5%. (N.W.R.)

28831 MEAN SQUARE INSTABILITY IN BOILING REACTORS. A. Z. Akcasu (Argonne National Lab., Ill.). Nuclear Sci. and Eng., 10: 337-45(Aug. 1961).

The dynamic behavior of boiling water reactors at high powers is investigated, using a model in which the reactor system is represented by a second-order differential equation with a random damping factor and a random driving function. It is found that the mean square value of power becomes divergent (instability in the mean square sense) at a power level which is lower than the instability threshold usually predicted by the conventional transfer function analysis (instability in the mean). A method for predicting the mean square instability threshold during the initial power rise is also described. This method consists of plotting the inverse of the root mean square of the power fluctuations as a function of the average power level, and determining the power at which the extrapolated curve intersects the x axis. The observed occurrence of ascillatory wave trains in the power fluctuations is also accounted for. (auth)

28832 MODIFYING EBWR VESSEL FOR 100-Mw(th) OPERATION. Joseph M. Harrer and Thomas L. Kettles (Argonne National Lab., Ill.). Nucleonics, 19: No. 8, 50-3 (Aug. 1961).

In order to increase the power output of the Experimental Boiling Water Reactor from 20 to 100 Mw(th), nozzle sizes were increased and other changes were made on the reactor pressure vessel. During the modification process, the reactor fuel and control rods were removed and lead and water shielding were used to protect personnel. (T.F.H.)

Production Reactors

28833 (CF-61-7-87) XENON CHASE AND SAMARIUM BURNUP IN THE HFIR. R. D. Cheverton (Oak Ridge National Lab., Tenn.). July 21, 1961. 14p.

Calculations were made in connection with xenon and samarium transients in the HFIR, including associated variations in the power distribution. Of particular interest was the possibility of burning samarium out of a core that was shutdown for a prolonged period of time after eleven or more days of operation at full power. The results indicate that such a core between the ages of 11 and 13 days old can complete the normal 15-day cycle after samarium burning times of zero to 50 days, respectively, in a 1.0-Mw natural convection cooling facility. A core shutdown for a prolonged time after 13 days could not complete the 15-day cycle. The

variations in power distribution associated with the xenon and samarium transients do not appear to be a problem if the hotspot heat flux is limited only by the maximum permissible fuel plate temperature. In any event, the maximum increase in hot-spot heat flux above normal is only 15%. (auth)

28834 (CF-61-8-57) SOLUTION CRITICAL EXPERIMENTS FOR THE HIGH FLUX ISOTOPE REACTOR: PRELIMINARY CALCULATIONS. H. C. Claiborne (Oak Ridge National Lab., Tenn.). Aug. 15, 1961. 36p.

A condensed version of this report was presented on Dec. 12, 1960, at the San Francisco meeting of the American Nuclear Society under the title, "Solution Critical Experiments for High Flux Isotope Reactor Studies: Part B, Calculations."

Nuclear calculations were made for critical experiments of a flux-trap type reactor that, neutronwise, resembled the proposed High Flux Isotope Reactor. The purpose was to evaluate the adequacy of certain calculational models for use in HFIR studies. In general, it was concluded that a multigroup two-dimensional calculation is required before there is a possibility of good agreement between theory and experiment. (auth)

Research Reactors

28835 (AE-55) THE SWEDISH ZERO POWER REACTOR R0. Olof Landergård, Kaj Cavallin, and Georg Jonsson (Aktiebolaget Atomenergi, Stockholm). 1961. 31p.

The reactor R0 is a critical facility built for heavy water and natural uranium or fuel of low enrichment. The first criticality was achieved September 25, 1959. The reactor tank is 3.2 m high and 2.25 m in diameter. The fuel suspension system is quite flexible in order to facilitate fuel exchange and lattice variations. The temperature of the water can be varied between about 10 and 90°C by means of a heater and a cooler placed in the external circulating system. The instrumentation of the reactor has to meet the safety requirements not only during operation but also during rearrangements of the core in the shutdown state. Therefore, the shut-down state is always defined by a certain low "safe" moderator level in the reactor tank. A number of safety rods are normally kept above the moderator ready for action. For manual or automatic control of the reactor power, a specially designed piston pump is needed, by which the moderator level is varied. The pump speed is controlled from the reactor power error by means of a Ward-Leonard system. Moderator level measurement is made by means of a water gauge with an accuracy of ±0.1 mm. (auth)

28836 (AERE-BIB-135) REACTORS AT THE ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL. A List of Unclassified Documents and Published Articles. C. S. Sabel, G. A. Bell, and G. M. Wildish, comps. (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1961. 34p.

A bibliography is presented consisting of 175 references to books, journal articles, reports, and patent literature concerning the Harwell reactors: BEPO, DIDO, DIMPLE, GLEEP, HAZEL, LIDO, NEPTUNE, PLUTO, ZEPHYR, ZETR-I, ZETR-II, and ZEUS. The main characteristics of the reactors are tabulated for: startup date, peak neutron flux, maximum heat output, moderator, coolant, fuel, and purpose. An author index is included. (B.O.G.)

28837 (IDO-16657) MTR THERMAL NEUTRON FLUX MEASUREMENTS FOR CYCLE 146. L. D. Weber and C. H. Hogg (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). May 31, 1961. Contract AT(10-1)-205. 93p.

The thermal neutron fluxes in selected positions of the MTR are measured. Data are included for a clean core (0 MWD), a depleted core (564 MWD), and an integrated core (394 MWD). Vertical traverses for each position monitored are shown. Measured cadmium ratios for "thin" cobalt in various positions are included. (auth)

28838 (LA-2569) NEUTRON TISSUE DOSE RATE SURVEY FOR THE GODIVA II CRITICAL ASSEMBLY. Morris J. Engelke, Edwin A. Bemis, Jr., and J. A. Sayeg (Los Alamos Scientific Lab., N. Mex.). May 1961. Contract W-7405-eng-36. 15p.

A neutron tissue dose rate survey was made for the Godiva II critical assembly using the Hurst neutron proportional counter. Measurements were made at 10 points from 40 to 350 meters. The data indicated values of approximately 25 mrad/hr per 100 watts operating power at 40 meters to 0.25 mrad/hr per 100 watts operating power at 350 meters. The results are consistent with the mean free path of 250 meters. The data are estimated to be uncertain by no more than 30%. (auth)

28839 (NDA-2131-40) PAWLING LATTICE TEST RIG—TEST REPORT NO. 1, PLATR—PCTR COMPARISON. W. L. Brooks, M. R. Fleishman, G. G. Foster, and R. D. Schamberger (United Nuclear Corp., White Plains, N. Y.). June 1, 1961. Contract AT(30-1)-2303(IX). 27p.

A heterogeneous, natural uranium lattice, with a D_2O moderator, is studied in the Pawling Lattice Test Rig (PLATR) with two moderator purities. The results are compared with a similar study made in the PCTR. The measured values of k_∞ are 1.035 ± 0.006 for a D_2O purity of 98.1%, and 1.064 ± 0.005 for a D_2O purity of 99.7%. If these values of k_∞ are adjusted to account for the physical differences between the PLATR and PCTR lattices, taking into account the differences in fuel, cladding, and D_2O purity between the lattices, the results are k_∞ (corr. to PCTR) = 1.053 ± 0.006 (from 98.1% D_2O experiment at PLATR), and k_∞ (corr. to PCTR) = 1.057 ± 0.005 (from 99.7% D_2O experiment at PLATR). The value of k_∞ measured at the PCTR is 1.052 ± 0.003, at a D_2O purity of 99.7%. (auth)

28840 (ORNL-3069) MEASUREMENTS AT BEAM HOLE HB-2 OF THE OAK RIDGE RESEARCH REACTOR FOR SOUTH FACILITY MOVABLE SHIELD DESIGH STUDY. F. J. Muchenthaler, T. V. Blosser, J. M. Miller, and L. Jung (Oak Ridge National Lab., Tenn.). Sept. 15, 1961. Contract W-7405-eng-26. 37p.

A series of measurements were completed at Beam Hole HB-2 of the ORR, for use in designing a movable personnel and instrument shield for the ORR South Facility. They include thermal and fast-neutron spectra, both unattenuated and behind selected shield configurations, and fast-neutron and gamma dose rates behind about 38 configurations. Materials used for the shield mockups included lead, iron, borated polyethylene, polyethylene and concrete. An attempt was also made to measure the intensity of the scattered radiation from these configurations. Despite experimental complications, some general conclusions were drawn from the latter experiments. (auth)

28841 (SGAE-61/2 B) ARBEITSBERICHT UND VERSUCHSERGEBNISSE DES ASTRA-REAKTORS. (Work Report and Experimental Results from the ASTRA Reactor). H. Bildstein, A. Burtscher, H. Bruneder, H. Kratschmann, and A. Nedelik (Osterreichische Studiengesellschaft fur Atomenergie GMBH., Vienna). May 1961. 83p.

The experimental work performed at the ASTRA Reactor is reported. These include critical experiments, calibra-

tion of absorber rods, relative flux measurements, absolute flux measurements, determination of the weight factors of fuel elements, and determination of reactivity values of the fuel elements. The experimental methods used and the results obtained are described. The changes made in the circuitry and electrical hookups are indicated. (J.S.R.)

28842 (CEA-tr-X-375) LE PREMIER RÉACTEUR ATOMIQUE POLONAIS. (The First Polish Atomic Reactor). J. Aleksandrowicz and P. Szulc. Translated into French from Nukleonika, 3: No. 1, 27-43(1958). 28p.

The first Polish reactor is water cooled and moderated and uses 10% enriched U. It has a power of 2 Mw and a neutron flux of 2×10^{13} n/cm^2 sec. In the present article detailed data on its engineering characteristics, the construction of the reactor itself, the details of the vessel and auxiliaries, and the radiation protection precautions for the personnel and the environs are presented. (J.S.R.)

28843 PURIFICATION OF THE FEED WATER OF THE SWIMMING POOL OF THE JEN-1 REACTOR. II. PHYSICO-CHEMICAL CHARACTERISTICS OF THE RESINS USED IN THE DEIONIZING SYSTEM. J. A. Pérez Bustamante, M. Urgell Comas, T. Batuecas Rodríguez, F. de la Cruz Castillo, and R. Fernández Cellini (Junta de Energia Nuclear, Madrid). Anales real soc. espãn. fís. y quím. (Madrid), Ser. B, 57: 83-8(Feb. 1961). (In Spanish)

Following the study undertaken previously in order to select the most suitable system to be built in the JEN-1 reactor for the deionized feed water supply of the swimming pool, some basic resin characteristics were checked comparatively. Among them, total exchange capacity, basicity, molarity and molality of active groups in the resin network, real and apparent densities, swelling, and specific volume of the swelled resin matrix in standard form were determined by means of conventional techniques. The resin types under study were A-40, Dowex I, Dowex II, Dowex 21 K, Imac C-12, Zerolite FF, and Zerolite 225. (auth)

28844 A FAST NEUTRON BURST REACTOR. G. E. Blokhin, D. I. Blokhintsev, Yu. A. Blyumkina, et al. Atomnaya Energ., 10: 437-46(May 1961). (In Russian)

A fast-burst reactor constructed at the Joint Institute of Nuclear Research became critical in June 1960. The reactor is operating with periodic pulse power of nearly 1 kw. The half-width of the power pulse is 36 μsec. The pulse frequency varies from 8 to 80 pulses/sec. (tr-auth)

WASTE DISPOSAL AND PROCESSING

28845 (ANL-6322) THE FLUID-BED CALCULATION OF RADIOACTIVE WASTE. J. W. Loeding, E. L. Carls, L. J. Anastasia, and A. A. Jonke (Argonne National Lab., Ill.). May 1961. 69p. Contract W-31-109-eng-38.

Liquid radioactive wastes are converted into solids, with volume reduction factors of 3 to 8, by flash drying on finely screened, porous, inert solid particles (e.g. alumina) in a fluidized bed at 320 to 550°C. The wastes may be either aluminum nitrate-containing wastes from the processing of MTR-type fuel elements, or Purex Process wastes. Ruthenium is found to be the only volatile fission product in this temperature range. Methods are described for its removal from the fluidizing gas. (T.F.H.)

28846 (CF-61-7-3) WASTE TREATMENT AND DISPOSAL PROGRESS REPORT FOR APRIL AND MAY 1961. R. E. Blanco and E. G. Struxness (Oak Ridge National Lab., Tenn.). Aug. 1, 1961. 82p.

Activities are discussed of a program for the development and demonstration of integrated processes for treatment and ultimate disposal of radioactive wastes resulting from reactor operations and processing of fuel for the nuclear power industry. High-level waste calcination studies were made of incorporation of simulated Purex sulfate-bearing wastes in various phosphate glasses. No detectable ruthenium was volatilized during evaporation-calcination of Purex, Darex, or TBP-25 solutions containing 1.5M H_3PO_3 at 500 to 900°C. Close-coupled pot-calcination process tests were completed for a standard sulfate-bearing Purex waste treated to reduce sulfate volatility, and a TBP-25 aluminum-bearing waste. Low-level waste studies were made in a scavenging-ion process, in which, the decontamination factors were in accordance with design specifications and confirmed laboratory-scale results. A dosage of 125 ppm of PO_4^{3-}, as a supplement to normal lime-soda ash treatment increased removals of Sr-89 and -90, and Cs-137 from 79 to 87% and 85 to 97%, respectively. A study was undertaken to evaluate the economics and hazards associated with alternative methods for waste disposal from a plant processing 1500 ton/yr of 10000 MWD/ton uranium and 270 ton/yr of 20000 MWD/ton thorium. A cost study is in progress for the construction of a plant for the conversion of wastes to solids by pot calcination. Analyses were made of wells drilled for waste disposal by hydraulic fracturing. Field tests, and plastic-flow and thermal studies were conducted for disposal of acid and neutralized wastes in natural salt formations. The effects of the waste liquids of salt cavities were studied by measuring the effects of various solutions on salt blocks at 25 and 75°C. Estimates of the activities of Sr-90, Cs-137, Ru-106, and Co-60 were made in the bottom sediments of the Clinch River. Sorption studies were conducted for strontium with natural and treated vermiculite at various pH values from 4 to 9. The addition of potassium salts was found to increase the sorption of cesium by natural vermiculite by changing the sorption mechanism from edge fixation to interlayer fixation. Gross activities of up to 31 c/m/ml were detected in observation wells in Burial Ground No. 4, which were found to vary with the sampling period. The first month of stream monitoring below the northeast portion of the drainage basin showed that 7.6 mc of Sr-89 and -90, 2.7 mc of rare earths, 0.53 mc of Cs-137, and 0.013 mc of Zr-95–Nb-95 were released to White Oak Creek. (B.O.G.)

28847 (DLCS-2390101) PERIODIC WASTE DISPOSAL SYSTEM MATERIAL BALANCE TEST. CORE 1, SEED 2. Test Evaluation T-641317. Section 1. (Duquesne Light Co., Shippingport, Penna.). First issue, June 30, 1961. 20p.

A test was carried out to determine the adequacy of storage capacity and operating procedures of the radioactive waste disposal system during a normal reactor plant warmup. The capacity and operating procedures were found to be adequate. It was impossible to perform a complete material balance based on existing level instrumentation and using the data required by the test procedure. Approximately 21,290 gal. of waste were received in the system and 13,210 gal. were discharged to the river with a total activity of 1200 μc. A quantity of 6,670 gal. of reactor coolant effluent was processed. Approximately 634 lb of combustible waste were incinerated. (M.C.G.)

28848 (HW-56821) TEMPERATURE TRANSIENTS IN UNDERGROUND TANKS STORING NUCLEAR PROCESS RESIDUES. D. W. McLenegan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 28, 1958. Contract AT(45-1)-1350. 45p.

The heat transfer study was made for a tank consisting of concrete with a steel liner to determine the relative temperature of the steel liner and the concrete tank bottom, the feasibility of higher temperature waste solutions causing buckling of the tank walls, the feasibility of using insulation to retard downward heat flow, and the feasibility of using cooling coils to reduce tank-bottom temperatures for existing tanks and those for future use. (B.O.G.)

28849 (HW-62958) THE RETENTION OF PARTICLES IN DUCTS TRANSPORTING AEROSOL STREAMS. Interim Report. A. K. Postma and L. C. Schwendiman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1, 1960. Contract AT(45-1)-1350. 10p.

Experiments were designed and equipment assembled which allows a quantitative measurement of particle retention rates as influenced by the particle and stream parameters believed important: particle size and density, particle concentration, duct diameter, duct surface condition, and gas velocity. Preliminary data show initial particle deposition in one-inch pipes to be approximately proportional to the 5th power of the gas velocity and 4th power of the particle diameter. Other observations concerning deposition and retention are reported. (auth)

28850 (HW-69257) RADIATION EFFECTS ON SOME WASTE FIXATION MATERIALS. A Bibliography. Richard Fullerton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1, 1961. Contract AT (45-1)-1350. 44p.

A bibliography is presented consisting of 360 references to studies of radiation effects on materials used in the fixation and storage of radionuclides. The materials considered are minerals, glasses, ceramics, and salts. The references included information on investigations of fundamental properties resulting from radiation-induced changes, and on the radiation effects on properties of concern in the application of the substance to a specific purpose. The literature cited includes work published prior to January 1, 1960. (B.O.G.)

28851 (HW-69500(p.147-50)) EFFECT OF TREATMENT OF REACTOR EFFLUENT ON RADIONUCLIDES IN FISH. P. A. Olson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Treatment of reactor effluent water by passage through beds of aluminum turnings is under consideration as one

means of reducing the concentration of certain radionuclides. Such treatment of the effluent was effective in reducing the P^{32} content in fish by more than 50%. (auth)

28852 (ORNL-2986) LABORATORY DEVELOPMENT OF A POT CALCINATION PROCESS FOR CONVERTING LIQUID WASTES TO SOLIDS. H. W. Godbee and J. T. Roberts (Oak Ridge National Lab., Tenn.). Sept. 14, 1961. Contract W-7405-eng-26. 50p.

Simulated Darex, Purex, Thorex, and TBP-25 wastes were batch-evaporated and calcined to solids. The weight of residue was decreased to ~8% of the original waste for Darex, to ~4% for Purex, to ~2% for Thorex, and to ~7% for TBP-25 by calcination to 1200°C. Semicontinuous evaporation and calcination to solids at 900°C of Darex and Purex wastes gave volume reduction factors of ~8 and 7 to 10, respectively. The nitrate contents of the residues from batch calcination to 800°C were from ~0.07 to 0.5 wt.% while the nitrate contents of the residues from semicontinuous calcination to 900°C were from ~0.1 to 0.7 wt.%. Sodium, calcium, and magnesium additives to Purex waste decreased the percent of sulfate volatilized into the condensate from ~30% to <0.5%. Replacement of the atmosphere above the waste with nitric oxide decreased ruthenium volatility from 50 to 60% of that originally present in Purex waste to 0.5 to 3.5%. The thermal conductivities for the calcined wastes, measured in situ, were all >0.1 Btu/hr ft °F at ~400°F and increased almost linearly with increasing temperature to >0.3 Btu/hr ft°F at ~1600°F in all cases studied. (auth)

28853 (ORNL-3128) EVALUATION OF ULTIMATE DISPOSAL METHOD FOR LIQUID AND SOLID RADIOACTIVE WASTES. PART I. INTERIM LIQUID STORAGE. R. L. Bradshaw, J. J. Perona, J. T. Roberts, and J. O. Blomeke (Oak Ridge National Lab., Tenn.). Aug. 22, 1961. Contract W-7405-eng-26. 32p.

As the first part of a study to evaluate the economics of the various steps leading to and including the permanent disposal of high-activity liquid and solid radioactive waste, costs of interim liquid storage of acid and alkaline Purex and Thorex wastes were estimated for storage times of 0.5 to 30 years. A 6-ton/day plant was assumed, processing 1500 tons/year of uranium converter fuel at a burnup of 10,000 Mwd/ton and 270 tons/year of thorium converter fuel at a burnup of 20,000 Mwd/ton. Tanks of Savannah River design were assumed, with stainless steel construction for acid wastes and mild steel construction for neutralized wastes. The operating cycle of each tank was assumed to consist of equal filling and emptying periods plus a full (or dead) period. With interim storage time defined as filling time plus full time, tank costs were minimum when full time was 40 to 70% of the interim storage time, using present worth considerations. For waste storage times of 0.5 to 30 years, costs ranged from 2.2×10^{-3} to 9.5×10^{-3} mill/kwh$_e$ for acid wastes and from 1.7×10^{-3} to 5.1×10^{-3} mill/kwh$_e$ for neutralized wastes. (auth)

28854 DISPOSAL OF RADIOACTIVE WASTE. FLOW RATE OF SOLIDS AND ADSORPTION OF RADIO ELEMENTS. P. Bovard and G. Monnot (Commissariat à l'Energie Atomique, Paris). Centre belge etude et document. eaux, Bull. trimestr. CEBEDEAU, No. 48, 135-42 (1960/II). (CEA-1862). (In French)

Control of the radioactivity of a medium demands a knowledge of the phenomena of diffusion and accumulation. With this aim, the distribution of contamination in different elements of pools near Saclay is studied. By far the greatest amount is fixed on the silt. The influence of pH on the adsorption of Sr^{90}, Y^{90}, Cs^{137}, and Ru^{106} on glass and granular materials such as: Fontainebleau sand, quartz, feldspar, and mica was also studied. The adsorption of Ru^{106} can be considered as negligible; as for Cs^{137} and Sr^{90}, the adsorption is the greatest at about pH 7. (auth)

28855 INSECT-VEGETATION RELATIONSHIPS IN AN AREA CONTAMINATED BY RADIOACTIVE WASTES. D. A. Crossley, Jr., and Henry F. Howden (Oak Ridge National Lab., Tenn. and Entomology Research Inst., Ottawa). Ecology, 42: No. 2, 302-17(Apr. 1961).

The development of insect populations on vegetation growing on White Oak Lake bed was followed for 3 years (1956 to 1958), immediately following the draining at White Oak Lake. This lake had served as a final holding basin for Oak Ridge National Laboratory's low-level wastes, and the alluvial terrain exposed upon drainage contained significant concentrations of radioisotopes, including Sr^{90} and Cs^{137}. The insect biomass, estimated by sweep-net and box-trap methods, was about 200 to 300 mg/m^2. No change could be demonstrated during the seasons, and evidently little change occurred between years. Significant concentrations of both Sr^{90} and Cs^{137} were found in samples of herbivorous insects. Concentrations of Sr^{90} were about 25% of the soil values, and Cs^{137} concentrations were about 1% of the soil values. However, the biomass of insects was minute compared to plant and soil masses, and the herbivorous insects contained but a minute fraction of the fission products in the system, since the bulk of these radioisotopes is in the soil. A sizeable fraction of the materials taken up by plants, however, may pass through the herbivorous insects in the system. Insect populations were followed in 2 areas each of smartweed, sedge-rush, and willow vegetation. Each of the vegetation types acquired its own characteristic insects. First-year insect populations tended to be dominated by one or a few species represented by many individuals. The second-year populations showed a reduction in numbers for the dominant species and an influx of additional species, accompanying an increase in plant diversity. No such reduction of the dominant species occurred in the willow areas, presumably because the willows were increasing their coverage each year, and additional species of plants were not invading the willow stands. (auth)

28856 NOT CONVENTIONAL LOW-LEVEL RADIOACTIVE LIQUID WASTES TREATMENT PROCESSES AND DISPOSAL OF HIGH-LEVEL AQUEOUS WASTES. Guido Branca (C.N.R.N., Rome). Ing. sanit. (Milan), No. 4: 138-54(1960). (CNEN-50). (In Italian)

Some particular processes for the decontamination of low-level radioactive liquid wastes, such as electrodialysis incoporating selective membranes and granular ion exchangers and slurrying with clay or powdered metal, are reviewed. The principal methods of disposal of high-level aqueous wastes, with or without preliminary insolubilization, are also described.

28857 DESIGN OF STORAGE TANKS FOR HIGHLY RADIOACTIVE WASTE PRODUCTS. Thomas Jaeger. Kerntechnik, 3: 307-12(July 1961). (In German)

Based on a description of structures completed, a survey on the structural problems in the design of large storage tanks for highly radioactive waste liquids from the radiochemical separation process is presented. The principles for the design of storage chambers for solids with fission products incorporated in a high concentration are explained and a construction example is given for a smaller storage tank. (auth)

28858 IMPROVED METHOD OF HANDLING RADIOACTIVE MATERIAL. Rudolph Alberti. British Patent 871,336. June 28, 1961.

A method is described for quickly and effectively converting radioactive material into a form in which it may be handled, stored, transported, and disposed of more easily and simply, with less danger, and at a low cost. The method consists of mixing finely divided or dissolved radioactive material with a finely divided radiation-absorbent material having a specific gravity of at least four. The mixture is hardened by baking or by means of a hydraulic settling agent. If the radioactive material is in liquid form, the liquid is passed over the finely divided material either alone or mixed with filter material or ion exchange material to remove the radioactive material from the liquid. This method may be applied to gaseous material also. The radiation-absorbent material consists of heavy metal compounds, preferably barite powder or sludge. Peat may be added to the radiation-absorbent for absorbing purposes. (N.W.R.)

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INDONESIA
Bandung, Java, Bandung Institute of Technology

IRAN
Tehran, Tehran University Center for Nuclear Studies

IRAQ
Baghdad, Iraqi Atomic Energy Commission

IRELAND
Dublin, University College

ISRAEL
Rehovoth, Israel Atomic Energy Commission

ITALY
Milan, Centro di Studi Nucleari di Ispra del C.N.R.N.
Rome, Comitato Nazionale per le Ricerche Nucleari

JAPAN
Tokyo, Science Section, Diet Library

KOREA
Seoul, Office of Atomic Energy

LEBANON
Beirut, American University

LUXEMBOURG
Luxembourg, Ministry of Transport and Electricity

MEXICO
Mexico, D.F., Comisión Nacional de Energía Nuclear

NETHERLANDS
The Hague, Reactor Centrum Nederland

NEW ZEALAND
Wellington, Department of Scientific and Industrial Research

NORTHERN IRELAND
Belfast, Department of Industrial and Forensic Science

NORWAY
Lilleström, Institutt för Atomenergi

PAKISTAN
Karachi, Pak. AEC Laboratory

PERU
Lima, Junta de Control de Energia Atomica

PHILIPPINE REPUBLIC
Manila, Philippine Atomic Energy Commission

POLAND
Warsaw, Biura Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej

PORTUGAL
Lisbon, Junta de Energía Nuclear

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SWEDEN
Stockholm, Aktiebolaget Atomenergi

SWITZERLAND
Zurich, Institut für Physik, Eidg. Technische Hochschule

THAILAND
Bangkok, Office of the Thai Atomic Energy Commission, Department of Science

TURKEY
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Montevideo, Comision Nacional de Energia Atomica

VENEZUELA
Caracas, Instituto Venezolano de Investigaciones Cientificas

VIET-NAM
Saigon, Office of Atomic Energy

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Belgrade, Federal Nuclear Energy Commission

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New York, United Nations Headquarters
Washington, D. C., Inter-American Nuclear Energy Commission